A McGRAW-HILL PUBLICATION MAY 1961
ONE DOLLAR

Power

the magazine of energy systems engineering

Better scavenging for 2-cycle gas engines 61

MHD generation comes another step closer 66

Reluctance motors bid for constant-speed loads . . 72

Nomograph eases heat-transfer calculations 78

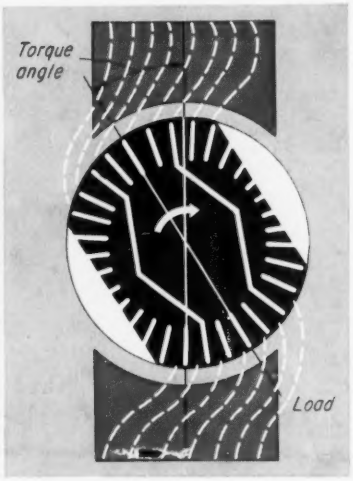
Building-block idea spreads to power transformers 80

SCR's ready up for industrial applications 83

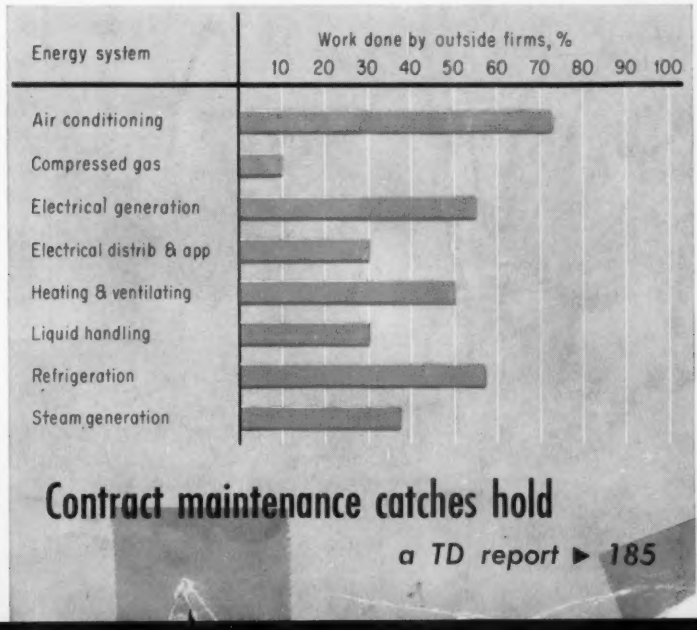
Practical facts about bolt-stretch, measurement . . . 190

How to equip instrument-service crews 192

Flood tip! Ways to dry transformer windings 196



DETROIT PUBLIC LIBRARY
MAY 1 1961
TECHNOLOGY DEPARTMENT



Contract maintenance catches hold

a TD report ▶ 185

NEW Butterfly Valve!

MATCHLESS LUNKENHEIMER QUALITY

FIG. 4026N

Complete Valve with Ends on Casting.
2"-6".
Screwed End.

FIG. 4150N

(Rubber-Lined: Fig. 4151R) Valve Elements Only.
2"-18". Screwed, Welded, Grooved, or Flanged Ends Supplied Separately to Fit Your Pipe Connections.

L-361-23

W. P. 150 psi.

- QUICK OPENING
- POSITIVE CLOSURE
- NICKEL-PLATED CAST IRON
- STAINLESS STEEL TRIM
- "O" RING SEALS

New Lunkenheimer Butterfly Valves are compact and lightweight, easy to install on any line in a fraction of the space required by standard gate or plug valves. A quarter-turn of the stem opens the disc full or closes it tight. No lubrication is required, and "O" Ring seals provide positive shut-off in either vacuum or pressure service. These new Butterfly Valves are made to traditional Lunkenheimer standards of quality. WRITE for new Catalog 613 or call your Lunkenheimer distributor today for full information on the new Lunkenheimer Butterfly Valve line . . . available now for immediate delivery.

LUNKENHEIMER®

THE ONE Great NAME IN VALVES

For more facts circle 201 on Reader Service card, p 103

THERE'S NO "OR EQUAL" TO DEARBORN'S ENDCOR® FOR COOLING WATER TREATMENT

1. No treatment. 2. Chromate-polyphosphate mixture—50ppm. 3. Chromate-polyphosphate mixture plus Endcor A—50ppm.
Unretouched photographs showing the effect of Endcor A in cooling water treatment at a pH of 6.5 and a temperature of 130° F.

Today, there's more than two years of performance proof behind Dearborn's cooling water treatments with the research developed additive, Endcor.

And today, more and more companies, with millions of dollars worth of cooling systems and equipment to protect, are striking out the "or equal" clause and directly specifying one of these Endcor products.

There's Polychrome ® 501 and 505 with Endcor A . . . Dearborn ® 860 with Endcor B . . . and others —all designed to do specific corrosion and deposit inhibiting jobs more precisely, more effectively, and, in many cases, more economically.

Behind these products are important "pluses," too. There's Dearborn's experience dating back to 1887 —longest in the water treatment field. There's its extensive research facilities . . . its modern, completely equipped laboratories to provide truly scientific answers to specific and baffling problems . . . its Technical Centers in Chicago and Toronto staffed with recognized experts to back up products and Dearborn engineers in the field.

Because of its critical importance to overall results, Dearborn also provides the most complete and effective line of chemical feeding equipment of any water treatment company.

We'll be glad to send you Technical Bulletins on our Endcor products. Or to consult with you on any water treatment problem, without cost or obligation. Call or write us today.

DEARBORN CHEMICAL COMPANY

General Offices: Merchandise Mart, Chicago 54 • Dallas • Des Plaines, Ill. • Ft. Wayne • Honolulu
Linden, N.J. • Los Angeles • Nashville • Omaha • Pittsburgh • Toronto • Havana • Buenos Aires

speaking of **Power**

Tomorrow's electrons, we have every reason to believe, will travel in more sophisticated circles than they do today. Although their end purpose in energy systems will remain essentially the same —to give light, to heat and cool, to turn the wheels of industry—how they start out on their more complicated journey will be influenced by results of today's research.

Many believe magnetohydrodynamic generators, fuel cells, thermoelectric units will soon make contributions to our generating capacity; how large remains to be seen. When they do, these sources will likely develop dc which must be inverted and transformed into usable ac of proper voltage. In all probability the silicon-controlled rectifier will figure prominently in the inversion. The SCR has the advantage of instantaneous starting without need for warmup. It promises to outshine the transistor at handling big blocks of power.

As ac, the electrons still must flow through transformers for needed stepup from the relatively modest generating voltage to a value more suitable for transmission and distribution. Such transformers will adopt power-to-grow features we see entering the picture today. Typical: the "building-block" concept where increased cooling facilities are added as needed to uprate a basic transformer—sized to handle the ultimate loads.

And when our electrons get to a motor, they may find an improved reluctance type being used where load needs dictate constant speed, especially in the more modest hp range.

Crystal gazing? Far from it. All these refined electron paths are with us today in some stage of development. For the latest on the SCR, the building-block concept for power transformers, the improved reluctance motor for constant speed, the MHD and thermoelectric generators, read on—as outlined in the facing table of contents.

Lon Lowley

L N ROWLEY — *Editor and Publisher*

B G A SKROTZKI — *Design and Application*
S M ELONKA — *Maintenance and Management*
J J O'CONNOR — *Managing Editor*
T W EDWARDS — *Associate Editor*
R H MARKS — *Associate Editor*
N PEACH — *Associate Editor*
L E STEWART — *Associate Editor*
P SCHWABE — *Assistant Editor*
C F MARSCHALEK — *Art Editor*

DOMESTIC NEWS BUREAU: Atlanta, Chicago, Cleveland, Dallas, Detroit, Los Angeles, San Francisco, Seattle, Washington, D. C.
WORLD NEWS OFFICES: Beirut, Bonn, Caracas, London, Mexico City, Moscow, Paris, Tokyo, Rio de Janeiro

CLARK BOUGHTON — *Sales Manager*

DISTRICT MANAGERS

ATLANTA 9, GA. – R K Burnet, 1375 Peachtree Street, NE, Trinity 5-0523 (Area Code 875)
BOSTON 16, MASS. – D L Kates, McGraw-Hill Building, Copley Square, Congress 2-1160
CHICAGO 11, ILL. – L W Romigh and T W McClure Jr, 645 North Michigan Avenue, Mohawk 4-5800
CLEVELAND 13, OHIO – R E Heisserman, 55 Public Square, Superior 1-7000
DALLAS 1, TEXAS – F LeBeau, 901 Vaughn Building, 1712 Commerce Street, Riverside 7-9721
DENVER 2, COLO. – J W Patten, Tower Building, 1700 Broadway, Alpine 5-2981
DETROIT 26, MICH. – L W Romigh, 856 Penobscot Building, Woodward 2-1793
HOUSTON 25, TEXAS – F E Holland, W-724 Prudential Building, Holcombe Blvd, Jackson 6-1281
LOS ANGELES 17, CALIF. – R H Antles, 1125 West Sixth Street, Huntley 2-5450
NEW YORK 36, N. Y. – G W Simpson and D L Kates, 500 Fifth Avenue, Oxford 5-5959
PHILADELPHIA 3, PA. – C R Long, Six Penn Center Plaza, Locust 8-4330
PITTSBURGH 22, PA. – R E Heisserman, 4 Gateway Center, Express 1-1314
ST. LOUIS 8, MO. – T W McClure Jr, Continental Building, 3615 Olive Street, Jefferson 5-4867
SAN FRANCISCO 11, CALIF. – T H Carmody, 255 California Street, Douglas 2-4600
LONDON W1, ENGLAND – M Thielé, McGraw-Hill Publishing Co, Ltd, 34 Dover Street
FRANKFURT-MAIN, GERMANY – S Kimes, McGraw-Hill Publishing Co, Inc, 85, Westendstrasse
GENEVA, SWITZERLAND – M R Zeynel, McGraw-Hill Publishing Co, Inc, 2, Place du Port

Print order this issue: 50,457

POWER (with which are consolidated *Science and Industry, The Engineer Review, The Engineer, The Stationary Engineer* and *Operating Engineer*) is published monthly by McGraw-Hill Publishing Company, Inc, James H McGraw (1860-1948), Founder. PUBLICATION OFFICE: McGRAW-HILL BUILDING, 330 W 42nd St, New York 36, N. Y. See box, right, for directions regarding subscriptions or change of address.
EXECUTIVE, EDITORIAL, CIRCULATION and ADVERTISING OFFICES: 330 W 42nd St, New York 36, N. Y. OFFICERS OF THE PUBLICATIONS DIVISION: Nelson L Bond, President; Shelton Fisher, Wallace F Traendly, Senior Vice-Presidents; John R Callaham, Vice-President and Editorial Director; Joseph H Allen, Vice-President and Director of Advertising Sales; A R Venezian, Vice-President and Circulation Coordinator. OFFICERS OF THE CORPORATION: Donald C McGraw, President; Joseph A Gerardi, Hugh J Kelly, Harry L Waddell, Executive Vice-Presidents; L Keith Goodrich, Vice-President and Treasurer; John J Cooke, Secretary.

Subscriptions are solicited only from executives, engineers and supervisory personnel engaged in design, operation and maintenance of the power and plant services in utilities, consulting and contracting firms, industrial and service plants. Position and company connection must be indicated on subscription orders. Send to address shown in box, right.

United States subscription rate for individuals in the field of the publication *$3.00 per year, single copies $1.00, unless otherwise indicated. Canada; $5.00 for one year. Foreign; $15.00 for one year. Second-class

In Power this month

MAY 1961 • VOL. 105 • NO. 5 • 79TH YEAR

Editorial: Cart before the horse? ____ 57

DESIGN AND EQUIPMENT APPLICATION

Better cylinder scavenging through patient research ____ 61
Magnetohydrodynamic generation of electric energy: results of a new study ____ 66
Thermoelectric generators take on new loads ____ 70
Constant-speed reluctance motors are simple, cost less ____ 72
Steps going up? Design them for safety and convenience ____ 74
How Florida P&L matched insulation to equipment needs ____ 76
Solve parallel- or counterflow heat transfer with these nomographs ____ 78
Building-block principle: an inexpensive way to uprate power transformers ____ 80
Silicon-controlled rectifiers get ready for industry ____ 83

DEPARTMENTS

Nuclear notes: News briefs on the latest developments ____ 86
Data sheet: Compare compressor power and capacity needs ____ 88
Technical briefs: A world-wide look at progress in energy-systems engineering ____ 92
New literature: Yours simply for mailing postage-free Reader Service card ____ 103A
Plant equipment news: Information center for new products and materials ____ 118
Thermo refresher: Steam nozzles and diffusers ____ 134
Marmaduke Surfaceblow advises the head-shrinkers ____ 146
Powerscope: A selective look at this month's power-field happenings ____ 162
Calendar ____ 170 *Appointments* ____ 174 *Bookshelf* ____ 178

PLANT MAINTENANCE AND MANAGEMENT

A *TD* report: Contract maintenance may cut your zooming costs ____ 185
Operators' notebook: Let's talk about bolt stretch and measurement ____ 190
How to equip instrument-service crews ____ 192
Static electricity cuts instrument accuracy—what can you do about it? ____ 194
Plant electrical fact file: Practical methods for drying transformers ____ 196
Plant problems: Here's how *Power* readers tackle them ____ 198
Practical ideas to keep your plant running at peak efficiency ____ 202
Keep electric tools safely grounded ____ 205

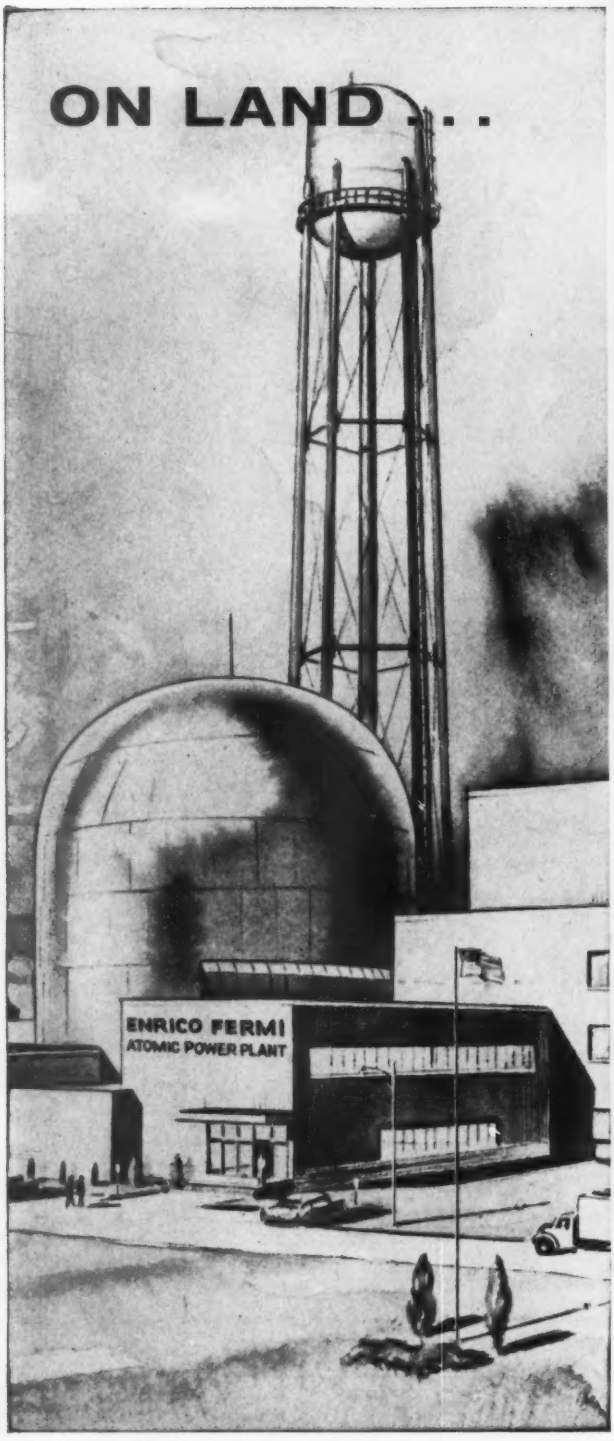
postage paid at New York, N. Y. and additional mailing offices. Printed in U.S.A. Title registered in U.S. Patent Office. © Copyright 1961 by McGraw-Hill Publishing Company, Inc. All rights reserved.

UNCONDITIONAL GUARANTEE: Our primary aim is to provide subscribers with a useful and valuable publication. Your comments and suggestions for improvement are encouraged and will be most welcome. The publisher, upon written request from any subscriber to our New York office, agrees to refund the part of the subscription price applying to copies not yet mailed.

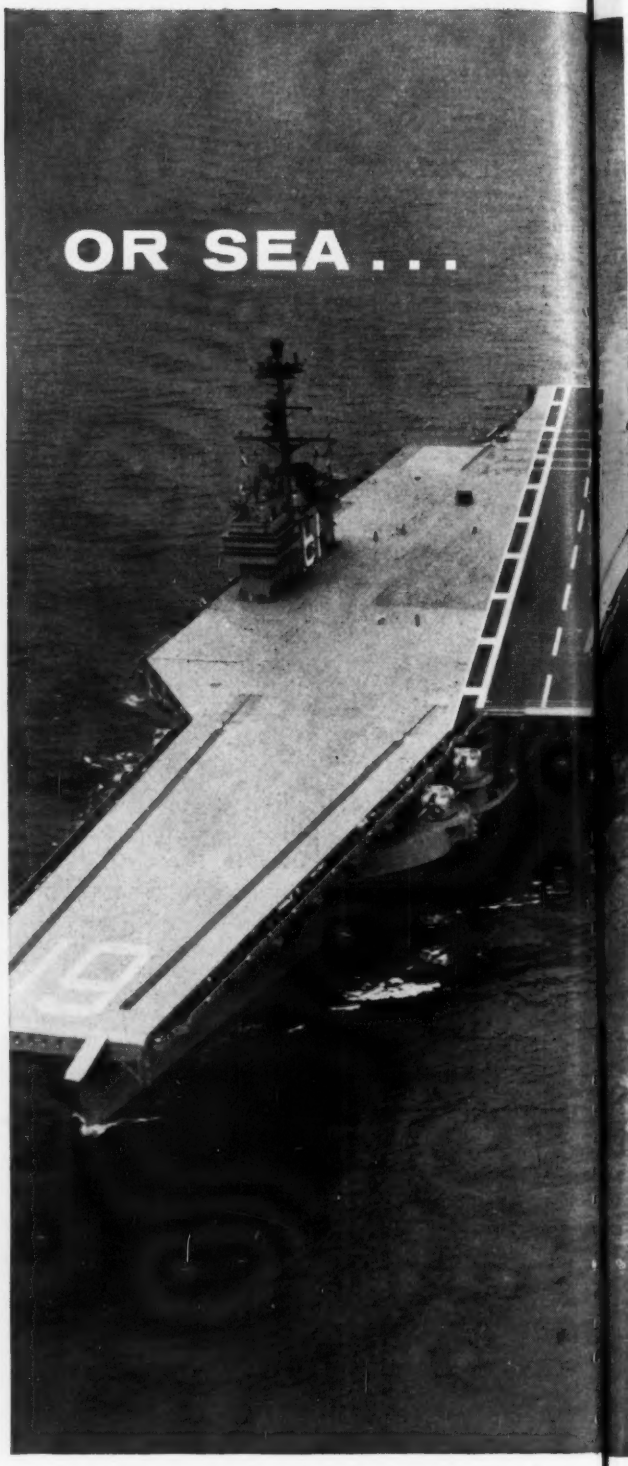
Power articles are indexed in both the *Industrial Arts Index* and the *Engineering Index*. POWER publishes its own annual index, obtainable on request to the Editor. Notice of availability appears in POWER.

SUBSCRIBERS: Send subscription correspondence and change of address to Fulfillment Manager, POWER, 330 W 42nd St, New York 36, N. Y. Subscribers should notify Fulfillment Manager promptly of any change of address, giving old as well as new address, and including postal zone number, if any (Official Post Office request). If possible, enclose an address label from a recent issue of the magazine. Since copies are addressed one to two issues in advance, please allow one month for change of address to become effective.

Postmaster: Send form 3579 to POWER, 330 W 42nd St, N. Y. 36, N. Y.



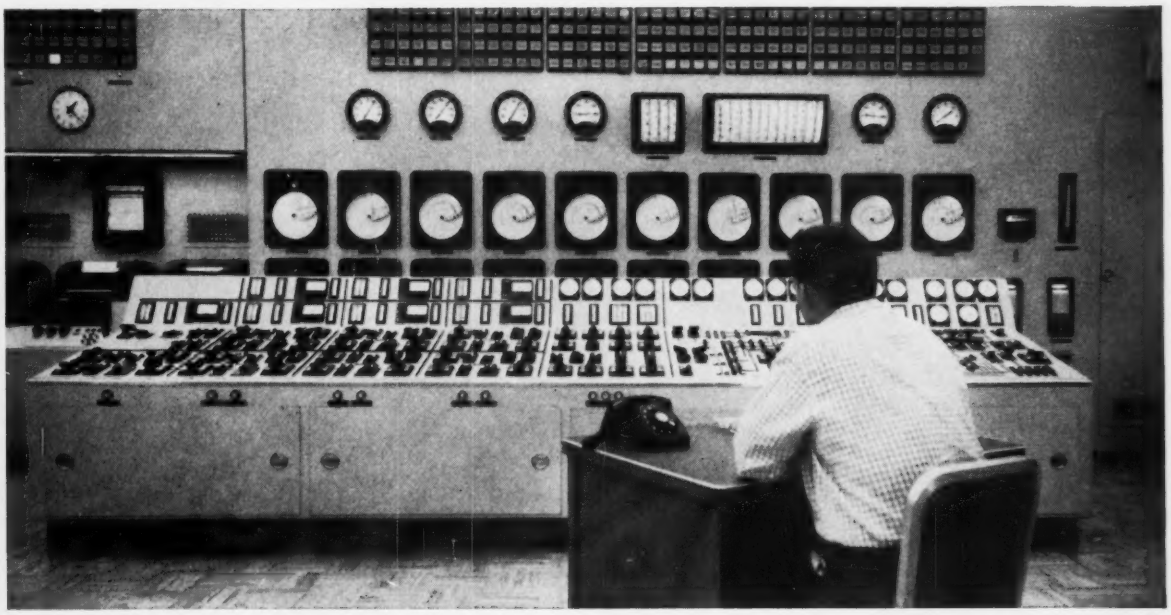
At the Enrico Fermi Atomic Power Plant, instruments and controls for both the "fast neutron breeder" reactor and the steam plant which it will "fire" are being furnished by Bailey.



Many of the new ships such as this super-carrier, USS Ranger, operate their boilers by Bailey Meter Control. Cargo ships, tankers, and passenger liners as well as Naval ships improve the economy and safety of their steam plants thru use of Bailey controls.

At the Thomas H. Allen Electric Generating Station of the City of Memphis, Tenn., Bailey operating indicators and controls for combustion, feed water, and steam temperature are centralized on the mechanical bench-board directly ahead, while the operating records which reflect trends are mounted on the vertical boards. A Bailey METROTYPE Information System, center left in the photo, scans, monitors, and logs functions usually assigned to strip-chart recorders.

IT'S BAILEY. . .



for the latest and safest instruments and controls for nuclear and conventional power plants!

Many of the power plants of the future will have controls and instruments designed and built by Bailey. There are two reasons: Bailey's continuing research and development toward the latest equipment for industry's needs; Bailey's 40-year association with the hardware and economic requirements of the industry.

If you are planning new or improved power plant facilities, call on Bailey engineers to assure that your system will have the *proper balance both as to economics and needs . . . that there will not be the unnecessary expense of over-instrumentation or control . . . nor the duplication of equipment functions.*

Call on Bailey for primary sensing devices, indicators, loggers, control units, panels, data handling equipment, computers for performance analysis, and supervisory controls. You'll find designs ranging from conventional to the most sophisticated . . . mechanical, pneumatic, electric and electronic, including solid state.

There's a Bailey District Office or Resident Engineer close to you. Check your phone book, or write direct.

A144-2

Instruments and controls for power and process

BAILEY METER COMPANY

1036 IVANHOE ROAD • CLEVELAND 10, OHIO

In Canada—Bailey Meter Company Limited, Montreal

For more facts circle 205 on Reader Service card, p 103

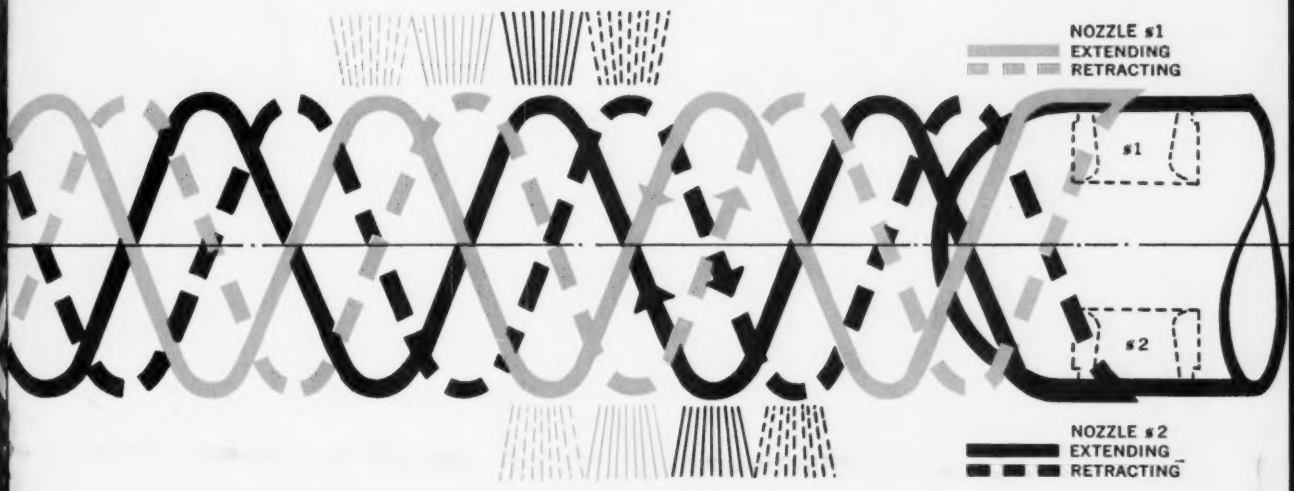
SHIFT AT REVERSE
SHIFT AT REVERSE

Diamond developed for more economical power...

A CLEAN SWEEP...EVERY INCH OF THE WAY

Get uniform, complete cleaning in those "tough-to-clean" zones. Specify Diamond's IK-300 Retractable Blower. The exclusive close-spaced IK helix assures a penetrating nozzle sweep every inch of travel regardless of tube bank arrangement and tube spacing. What's more, because sectionalized lance tube construction cuts deflection to a minimum, smaller boiler cavities are possible. In addition, a unique method of equalizing nozzle end-thrust assures "minimum-wobble" travel regardless of distance.

IK's are just part of the reason behind Diamond's established superiority in boiler cleaning systems. Add a complete line of cleaning equipment, an experienced, imaginative engineering staff and an unmatched service organization. No wonder thousands of utility and industrial power plants are equipped with Diamond Cleaning Systems — engineered and designed to provide you with more economical power.



Diamond

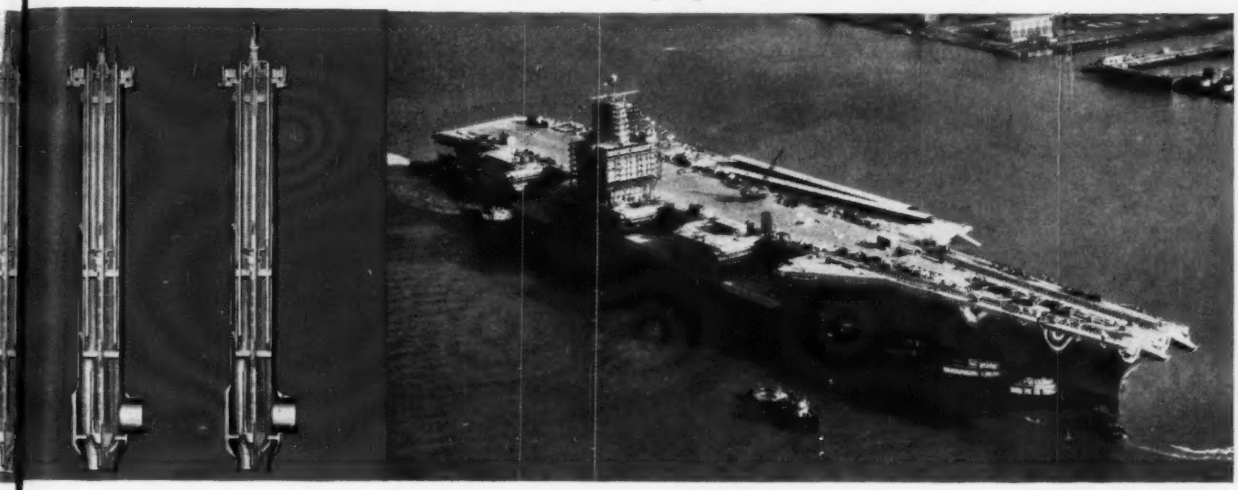
DIAMOND POWER SPECIALTY CORPORATION, Lancaster, Ohio • DIAMOND SPECIALTY LIMITED, Windsor, Ontario

For more facts circle 206 on Reader Service card, p 103

Official U. S. Navy photo

For

Aboard nuclear vessels, and in atomic-electric power plants, Copes-Vulcan nuclear valves meet challenging standards



Official U. S. Navy photo

There's no room for imperfection in today's nuclear projects. Because Copes-Vulcan builds its valves to meet and exceed exacting standards, they are widely used for nuclear applications. These valves provide precise control on some of the nuclear subs now at sea, and have been selected for more in a growing nuclear fleet. In addition, there are key atomic-electric power plant installations. Painstaking procedures produce valves meeting the most rigid requirements for leak tightness, resistance to corrosion, fail-safe operation, and ease of maintenance.

Components, produced by advanced methods on modern machine tools, are thoroughly cleaned and assembled in clean atmosphere. Where required, inspection is made by ultrasonic, radiographic and mass spectrometer methods. Testing can be conducted in hot or cold clean test loops. See how this manufacturing skill and integrity can pay off for you. Write for details, or visit the Copes-Vulcan facilities in Erie, Pennsylvania.

Copes-Vulcan Division

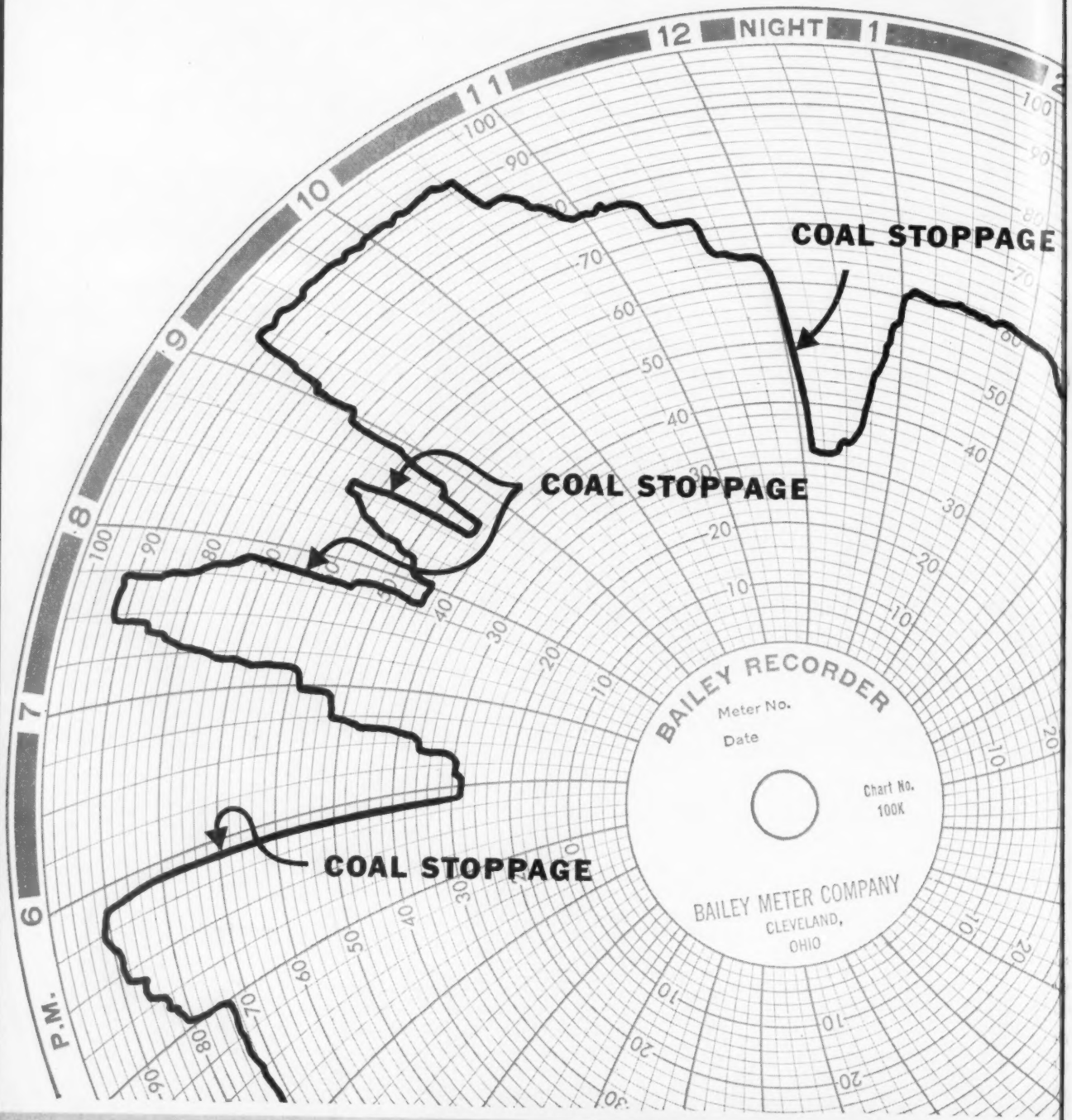
BLAW-KNOX

BLAW-KNOX

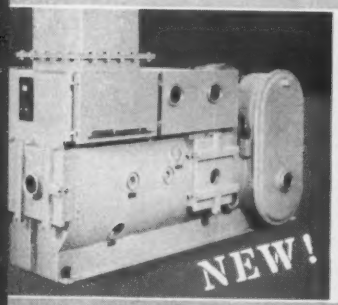
Blaw-Knox designs and manufactures for America's growth industries: METALS: Rolling Mills • Steel Processing Lines • Rolls • Castings • Open Hearth Specialties • PROCESSING: Process Design, Engineering and Plant Construction Services • Process Equipment and Pressure Piping • CONSTRUCTION: Concrete and Bituminous Paving Machines • Concrete Batching Plants and Forms • Gratings • AEROSPACE: Fixed and Steerable Antennas • Radio Telescopes • Towers and Special Structures • POWER: Power Plant Specialties and Valves

For more facts circle 207 on Reader Service card, p 103

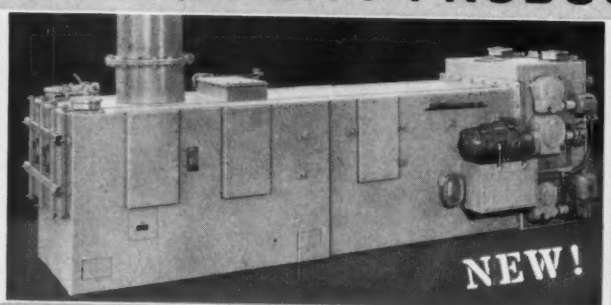
Circle 208 on Reader Service card for following ad ➤



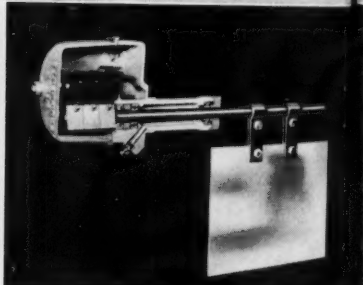
S-E-Co. QUALITY PRODUCTS



GRAVIMETRIC FEEDERS
Weigh and Feed



VOLUMETRIC FEEDERS
Feed Sticky Coals



STOPPAGE ALARMS
Two Types

HAVE YOU LOST LOAD because of COAL FLOW PROBLEMS?...if so YOU NEED S-E-CO. EQUIPMENT

Snow and rain, during the last several months, have combined with fine coal to cause much operating trouble. S-E-Co. Valves, Scales and Feeders are designed to handle the so-called "real estate" type of coal. S-E-Co. equipment will handle the coal all the way from the bunker to the feeder outlet in a stream 24" wide. This large size creates a downward pressure that keeps the coal moving.

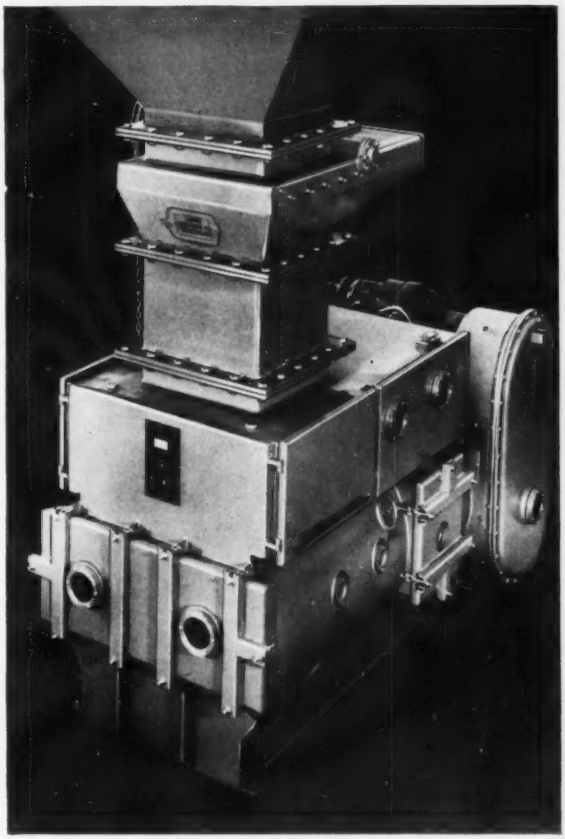
The S-E-Co. Twin 24" Coal Valve at the bunker outlet gives two 24" openings. With bad coal, this construction will create twin rat holes in the bunker. This is a weak condition, and the coal has a tendency to cave-in more readily and thus feed.

S-E-Co. Model 50 Coal Scales have vertical skirt plates on both sides so the coal is carried 24" wide on the belt. This width of feed gives greater assurance of proper flow.

S-E-Co. Volumetric and Gravimetric Feeders also carry the coal 24" wide so they, too, give a good account of themselves with hard-to-handle coal.

S-E-Co. Twin Coal Valves, Coal Scales, Gravimetric and Volumetric Feeders give you better equipment to cope with the sticking tendency of fine, wet, clayey, low grade coals.

If you have coal flow problems write:

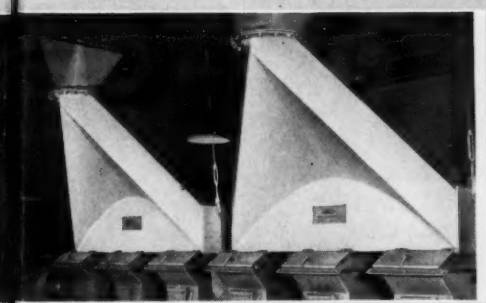


S-E-Co. Gravimetric Feeder

STOCK EQUIPMENT COMPANY

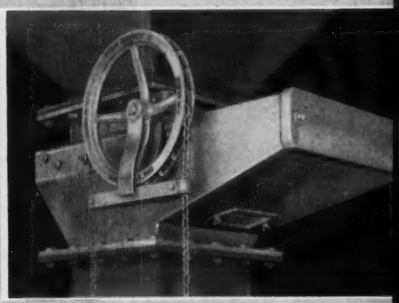
745 HANNA BUILDING • CLEVELAND 15, OHIO

S-E-Co. QUALITY PRODUCTS



CONICAL NON-SEGREGATING COAL DISTRIBUTORS

COAL SCALES
Two Basic Sizes



COAL VALVES
6" to 60" — Many Styles

Six marked differences make Elliott turbines a better buy

Why are Elliott YR turbines your best choice for mechanical drives? Some of the reasons are described on the opposite page. These are tangible reasons why you can expect dependable, economical operation with little care or attention.

With more than 50 years' experience in mechanical-drive turbines up to 50,000 hp; with the most complete line of field-proven machines; with engineering and service facilities nationwide: Elliott is clearly "Turbine Headquarters." Write for bulletin H22-D.

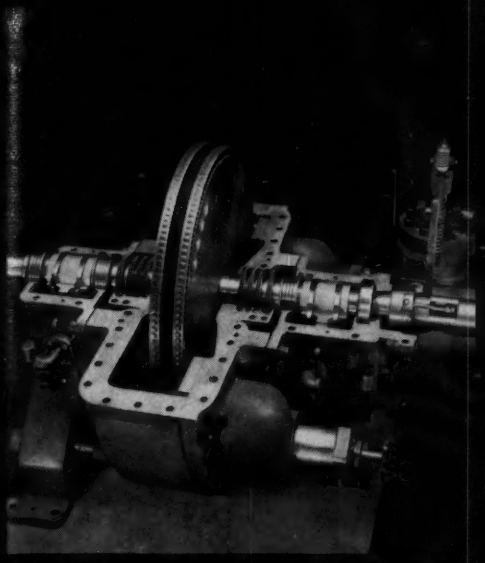
TURBINES FOR DEPENDABLE day-in/day-out SERVICE

H1-1

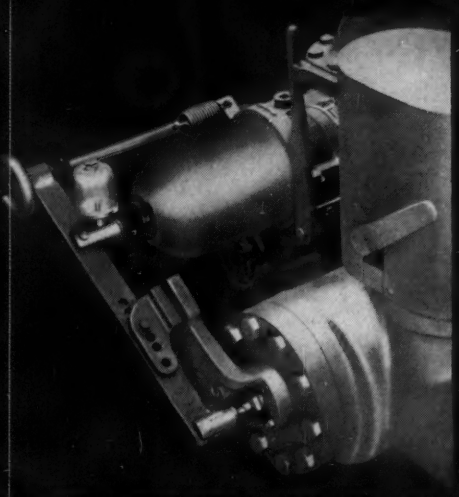
ELLIOTT COMPANY

GENERAL OFFICES: JEANNETTE, PENNSYLVANIA
PLANTS AT: Jeannette and Ridgway, Pa.; Springfield, Ohio
TURBINES • GENERATORS • MOTORS • COMPRESSORS
TURBOCHARGERS • EJECTORS • STRAINERS • TUBE CLEANERS

For more facts circle 209 on Reader Service card, p 103



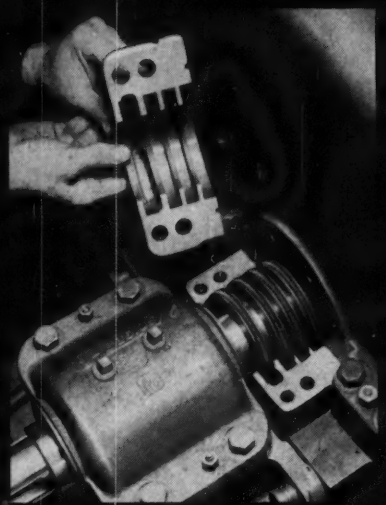
Precise alignment of shaft, through true centerline support, permits smooth and dependable operation at all operating temperatures.



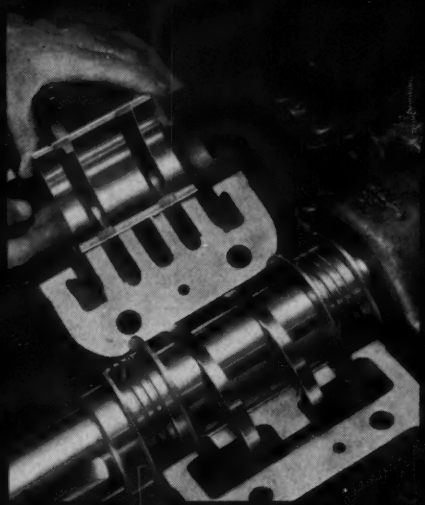
Simple, positive direct-acting speed-governing system is dependable, weather-proof, accurate. Separate trip gives positive overspeed protection.

These features mean dependable, economical turbine operation:

1. True centerline support
2. Positive speed control
3. Accessible shaft seals
4. Inexpensive bearings
5. Optional hand valve
6. Full protection

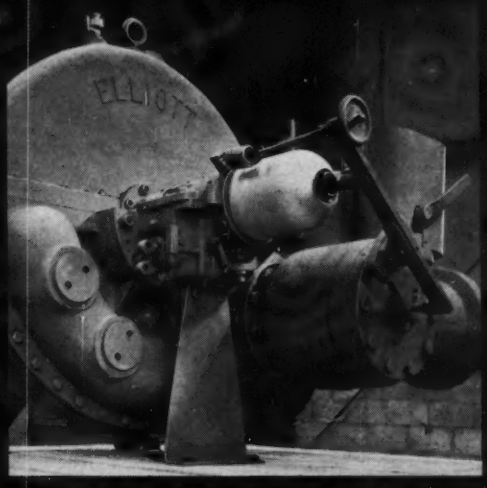


Accessible shaft-seals simplify maintenance and routine inspection. Covers readily removed without disturbing casing.



Inexpensive liner-type bearings readily installed with no scraping, fitting or adjustment required.

Steam-saving hand valve with pilot, which can be opened against full steam pressure, reduces steam consumption at partial loads.



All-weather protection is standard for Elliott YR turbines. They shrug off heat, snow, moisture, dust or contaminated atmosphere.

HERE'S WHY

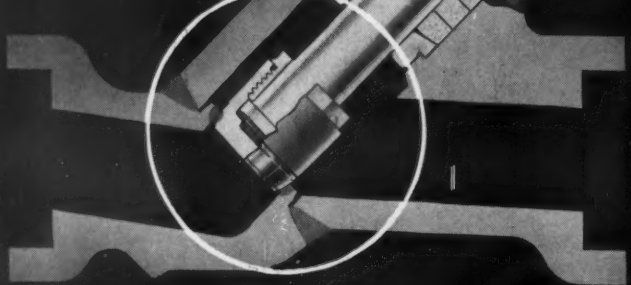
EASY-GRIP, VENTILATED HANDWHEEL

ACCESSIBILITY—all working parts readily removed through top of yoke. Jack action of stem forces out old packing.

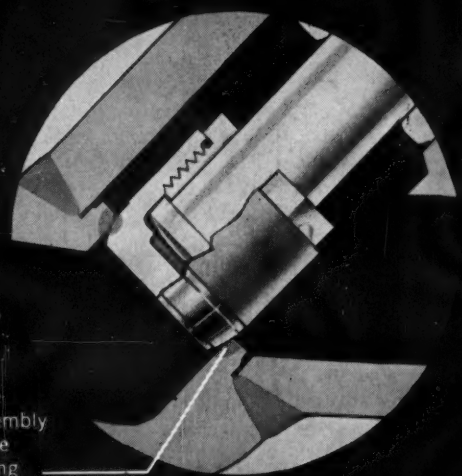
GUIDED VALVE STEM OF #321 STAINLESS STEEL
—will not "pit." Self-aligning, stellite-faced disc.

HIGH TEMPERATURE INHIBITED STEM PACKING
—furnishes double insurance against packing leaks.

ONE-PIECE FORGED CHROME-MOLY STEEL BODY AND YOKE



EASY FLOW BODY
Smooth inner contours, reduced pressure drop.



UNIQUE SEAT DESIGN
Thermal compensating groove prevents distortion during assembly welding and when welding valve into line, permits perfect seating of disc for positive seal. Integral seat is stellite-faced.

YARWAY WELBONDS® ARE SPECIFIED FOR HIGH PRESSURE/HIGH TEMPERATURE VALVE JOBS

WELBOND VALVES—designed specifically to provide better, longer maintenance-free service in high pressure/high temperature power plants—have won resounding acceptance from operators of modern steam plants everywhere. Welbond performance speaks for itself.

Why do Yarway WELBOND valves give these results? Because only WELBOND combines all these valve advantages:

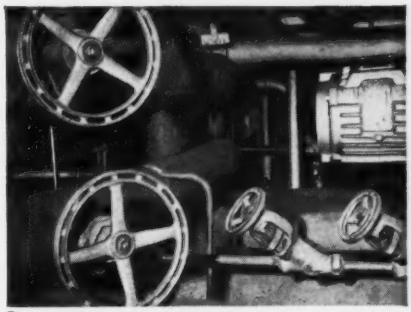
- ✓ Valve stem of 321 austenitic stainless steel prevents pitting. As an added precaution special inhibited packing gives still greater assurance against stem corrosion.
- ✓ Quick *accessibility* of all working parts through top of yoke.
- ✓ Unique seat design with thermal compensating groove provides non-distorting seat, assuring drop tight shut-off. Reseating tools available for quick "on the job" repairs to valve seat.
- ✓ One-piece forged chrome-moly steel body and yoke.
- ✓ Easy-grip, ventilated handwheel.
- ✓ Smooth inner contours, reduced pressure drop.

Yarway WELBOND valves are "proving their mettle" on high pressure boilers in all general services requiring small valves (¼″ through 2½″).

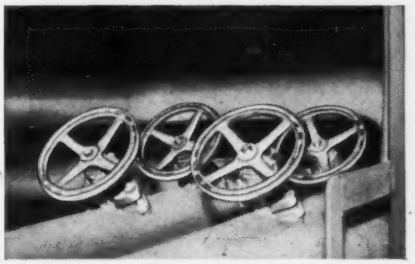
Try WELBONDS in *your* plant. Write for free Yarway Bulletin B-454.

YARNALL-WARING COMPANY
100 Mermaid Ave., Philadelphia 18, Pa.
BRANCH OFFICES IN PRINCIPAL CITIES

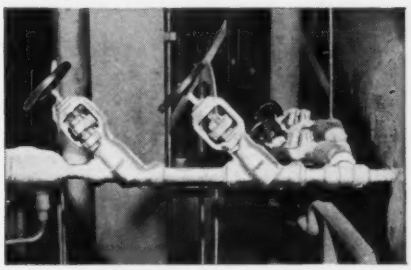
YARWAY
A MARK OF QUALITY IN STEAM ENGINEERING



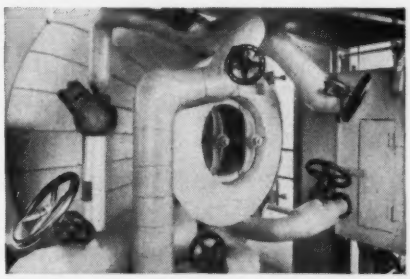
● Four of many Yarway Welbonds installed in large eastern public utility plant. Steam pressure 1850 psi; temperature 1000°F.



● Four of numerous Yarway Welbonds in station of large mid-west utility. These Welbonds installed on header drains.



● Four Yarway Welbonds on main steam line to turbine at southern power plant. Pressure 2310 psi; temperature 1000°F. Over 100 Welbonds in plant.

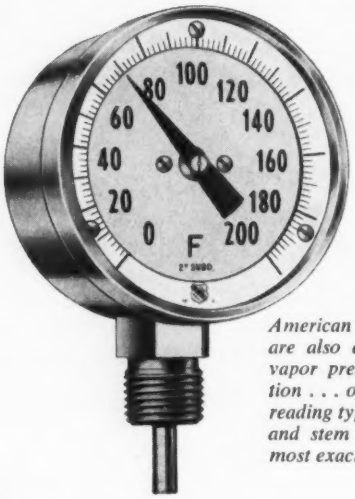


● Six of more than 900 Yarway Welbonds installed in various power plants of southwest utility. Boiler drum pressure in this plant—2150 psi; superheat temperature 1005°F.

For more facts circle 210 on Reader Service card, p 103

sharp

AMERICAN BI-METAL THERMOMETERS make accurate temperature readings sharp and sure at all check points



American Dial Thermometers are also available in mercury, vapor pressure, and gas actuation . . . on-the-spot and distant reading types . . . in sizes, ranges and stem lengths to meet your most exacting requirements.

sensitive

Any way you look at an American Bi-Metal Thermometer, you see exact working temperatures.

The two-level "Maxivision®" dial eliminates parallax effects. Numerals are on the lower level. Graduations are on the outer raised ring dial which presents a sheared edge to the tip of the pointer and in the same plane. To make readability even more accurate, the glass and graduated dial are closely spaced.

American Bi-Metal Thermometers are made of weather-proof stainless steel. All joints are welded to solid unity, then polished smooth so corrosion won't build up and destroy the thermometer's usefulness. And, you don't have to discard this thermometer if even the glass is broken. The bayonet lock bezel makes replacement easy.

Learn about the high sustained accuracy and long service life built into American Bi-Metal Thermometers. Phone your nearby industrial supply distributor for help in selecting the right type for each temperature check point in your plant. Or write for Catalog 155.

MANNING MAXWELL & MOORE, INC. TRADE MARK

AMERICAN INDUSTRIAL THERMOMETERS

A product of

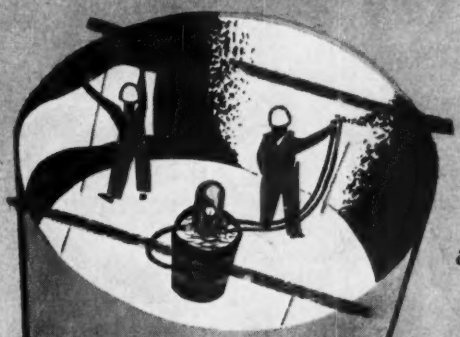
MANNING, MAXWELL & MOORE, INC.

Gauge and Instrument Division • Stratford, Connecticut

Canada: Manning, Maxwell & Moore of Canada, Ltd., Galt, Ontario
Latin America: Export Division, Chrysler Building, New York, N. Y.
Europe: Manning, Maxwell & Moore, S. A., Fribourg, Switzerland

For more facts circle 211 on Reader Service card, p 103

NOW POSITIVE CORROSION PROTECTION FOR THE INTERIOR OF BRICK, STEEL AND CONCRETE CHIMNEYS



Only material proved effective against acids formed by Sulfur Dioxide and Sulfur Trioxide.

foster® STACKFAS®

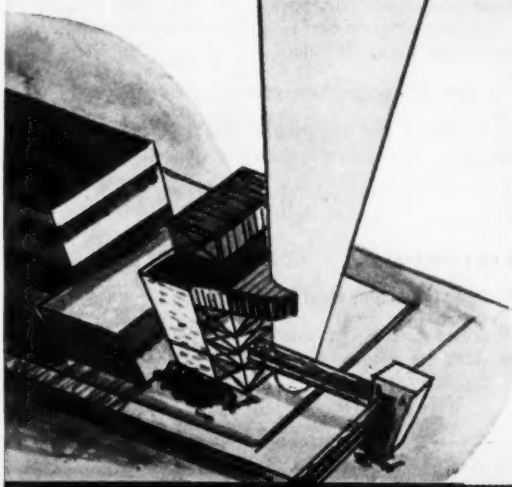
In recent years the cost of new chimney construction and maintenance has skyrocketed due to greater use of more economical low cost coal, heavy fuel oil, refinery sludge and sour gases which form stronger acids resulting from the use of these high sulfur fuels. The lowering of the gas temperatures through the use of economizers has increased the problem. Heretofore no coating has succeeded in resisting these highly corrosive acid gases.

Now, after two years of intensive research and testing, Benjamin Foster Company releases STACKFAS—the world's first exclusive corrosion resistant material proved effective against high sulfur chimney gases.

Foster STACKFAS has been field tested and proved by twenty-four major public utilities, chemical and industrial plants. Its development program had the cooperation of the nation's most renowned consulting engineers, insulation manufacturers and chimney constructors.

Rarely has a product been subjected to such wide study and testing. This cooperation was made possible because it was apparent from the outset that Foster STACKFAS would make obsolete all previous specifications and recommendations for the protection of chimneys and stacks against corrosive flue gases.

For complete details, specifications and applications of Foster STACKFAS, write for Bulletin No. SF-61.



foster COATINGS · SEALERS · ADHESIVES

BENJAMIN foster CO.
4635 W. GIRARD AVE. • PHILA. 31, PA.
Division of Amchem Products, Inc.

BENJAMIN foster CO. 4635 W. GIRARD AVE. • PHILA. 31, PA.

Please send me Bulletin SF-61. I understand there is no obligation.

Name_____

Company_____ Title_____

Street Address_____

City_____ Zone_____ State_____

For more facts circle 212 on Reader Service card, p 103

Now... a completely self-cased, MODULAR BOILER

C-E's NEW

DESIGN HIGHLIGHTS OF THE VU-60

Modular construction makes it possible to assemble custom designs from standardized components.

Boiler can be proportioned for best combustion, heat absorption and gas flow even when space conditions are limited or difficult.

Completely self-cased, the VU-60 is an all-welded gas-tight and pressure-tight envelope of finned furnace and boiler tubes. This results in less non-working weight per pound of steam capacity.

No external ductwork. The bottom of the boiler is a plenum chamber which allows air to flow direct from the air heater to the burner windbox.

Number of field-welded pressure parts is greatly reduced.

Cross flow baffling and symmetrical boiler bank mean low draft loss, no sluggish gas flow in any pass.

Requires only a simple, reinforced concrete slab. No conventional roller supports required.

Paneled construction cuts erection time.

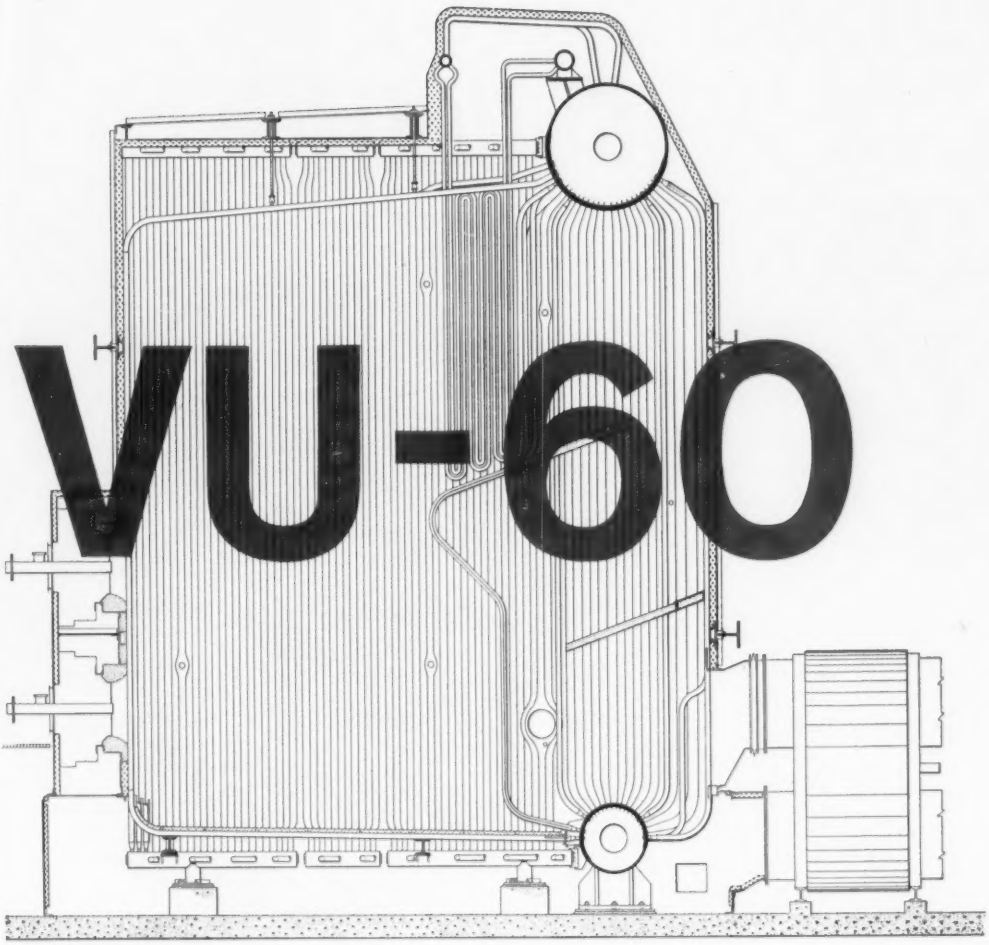
No air heater supporting steel is required.

For pressurized or induced draft firing. When pressurized, unit does not require induced draft fan.

VU-60 SPECIFICATIONS

Capacities:	100,000 to 250,000 lb per hr
Design pressures:	250, 500, 750, 1000 psi
Steam temperatures:	To 900 F
Fuels:	Oil and/or gas
Firing:	Horizontal (front wall) or tangential
Size increments:	Depth — twelve Width — eight Height — three
Steam drum sizes:	Four

ALL TYPES OF STEAM GENERATING, FUEL-BURNING AND RELATED EQUIPMENT; NUCLEAR REACTORS;



The VU-60 Boiler is a new and logical extension of C-E's service-proved VU series. Like all VU units, it is completely integrated, symmetrical in design, uncluttered and uncomplicated. Based on a standardized modular concept, it offers greater flexibility, yet stays within the bounds of solid and proven practice.

The VU-60 is a functional boiler. Completely self-cased, the exterior walls of this unit (furnace and boiler) are composed of finned tubes, shop welded into panels. The fins between panels are field welded to form a gas- and pressure-tight structure. Insulation is applied directly to the outside of these walls and is covered by pre-formed, field installed metal lagging. Thus non-working weight and bulk is reduced to a minimum.

The VU-60 is economical, it is dependable, it is accessible. It is easy to install and will meet your most exacting steam needs. Why not write for further information, or, if you prefer, contact the C-E office nearest you.

COMBUSTION C-E **ENGINEERING**

General Offices: Windsor, Conn. • New York Offices: 200 Madison Avenue, New York 16, N. Y.

Canada: Combustion Engineering-Superheater Ltd. C-300

PAPER MILL EQUIPMENT; PULVERIZERS; FLASH DRYING SYSTEMS; PRESSURE VESSELS; SOIL PIPE

52 FLOORS OF PERSONALIZED COMFORT

Johnson Control a Highlight in New Union Carbide Building

One of the nation's most exciting and modern structures, the Union Carbide Building contains over 1.1 million square feet of rentable floor space. Its air conditioning equipment includes a high-velocity conduit system with 6,000 perimeter induction units and, for the interior, a high-pressure dual-duct system with 54 central fan systems.

Throughout this pace-setting skyscraper, a specially planned Johnson Pneumatic Control System maintains an ideal climate for business efficiency. Some 4,000 thermostats, 4,000 control valves, and related controls were installed to assure personalized, air conditioned comfort at all times!

Shown above is one of two Johnson Pneumatic Control Centers located in the basement and one of the top floor offices. Their features include: continuous indication of room temperatures, air and water temperatures, and pressures at over 450 control points; remote adjustment of all systems; optional recording of any point shown; and schematic diagrams of all systems and their controls, plus a push-button viewer with zoned floor plans of each floor in the building.

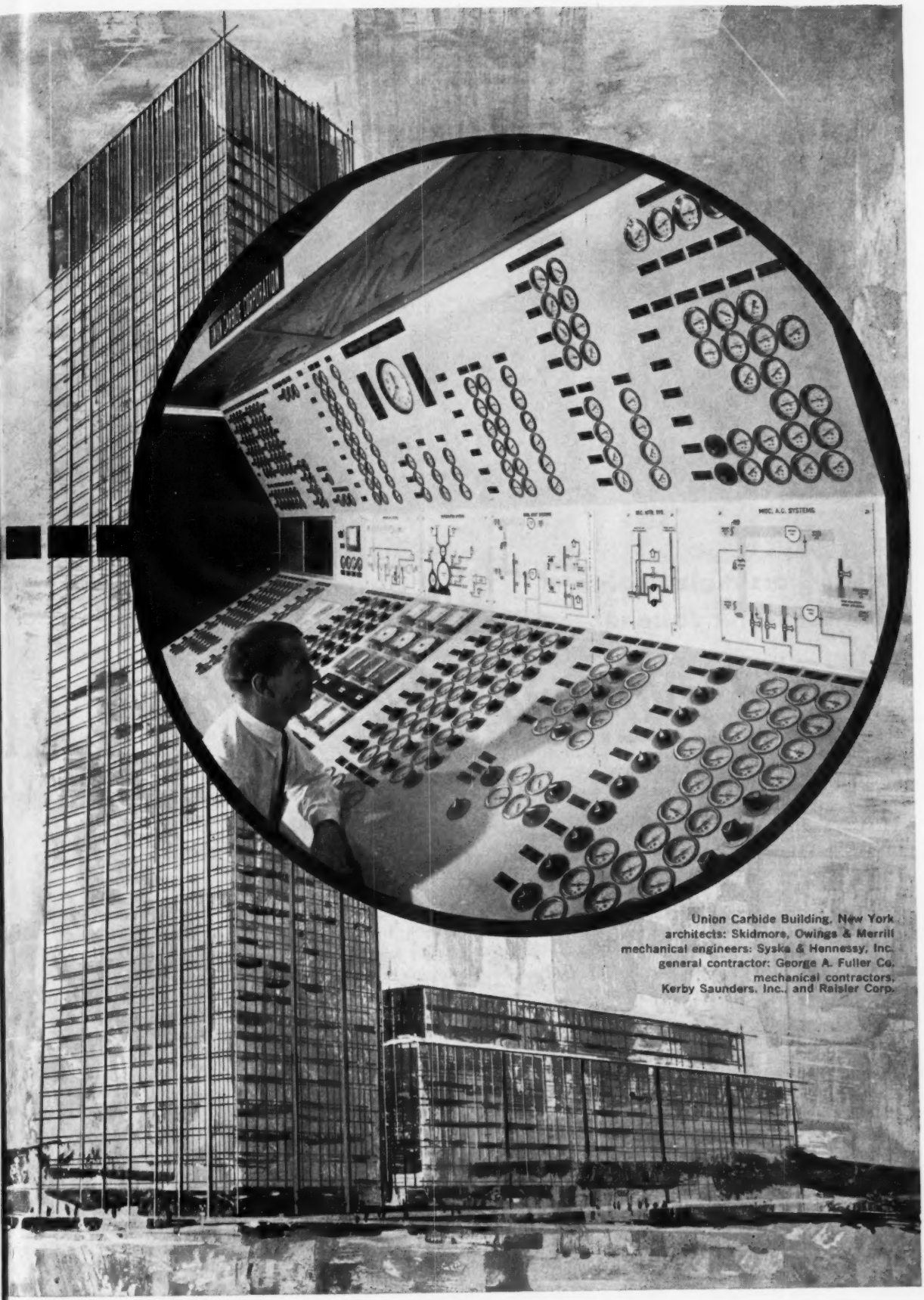
Engineered for economy as well as for comfort, the Johnson System makes possible major time and operational savings. With the aid of the control centers, for example, the number of man-hours required to supervise and control the vast network of primary air conditioning equipment is reduced to a minimum.

When you build or air condition, let Johnson provide your building with comparable benefits. Ask your architect, consulting engineer, or local Johnson representative to explain the unmatched performance and lifetime economy features of Johnson Pneumatic Control. Johnson Service Company, Milwaukee 1, Wisconsin. 105 Direct Branch Offices.

JOHNSON CONTROL

PNEUMATIC SYSTEMS

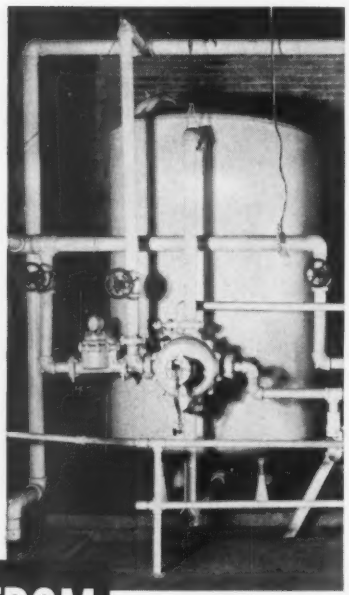
DESIGN • MANUFACTURE • INSTALLATION • SINCE 1885



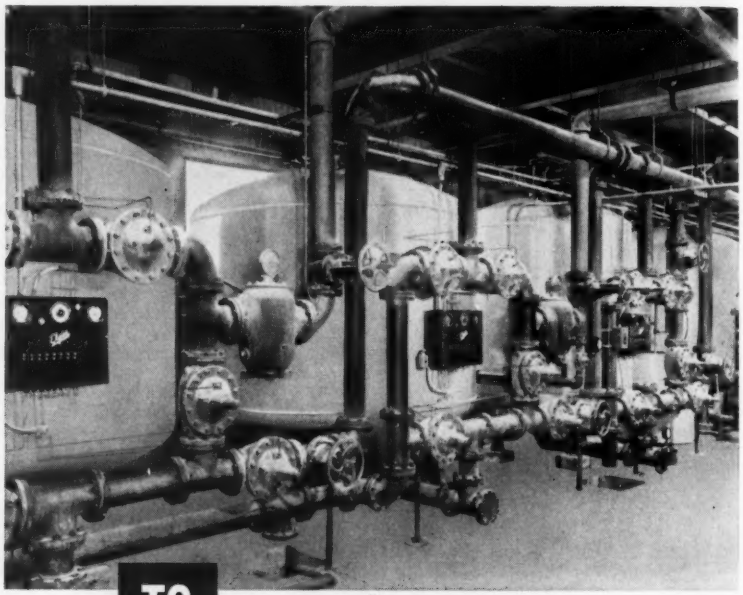
Union Carbide Building, New York
architects: Skidmore, Owings & Merrill
mechanical engineers: Syska & Hennessy, Inc.
general contractor: George A. Fuller Co.
mechanical contractors,
Kerby Saunders, Inc., and Reisler Corp.

For more facts circle 214 on Reader Service card, p 103

Elgin makes it!



FROM a simple zeolite water softener



TO a complex automatic deionizer

—and anything else in between

A firm like Elgin that can give you *anything* you need is obviously the firm that can give you the *right* thing.

Exactly the right thing! . . . the kind of equipment and installation that will give you maximum results at lowest cost . . . the kind of set-up that can only be assured by more than 50 years of intensive specialization in the difficult field of water conditioning.

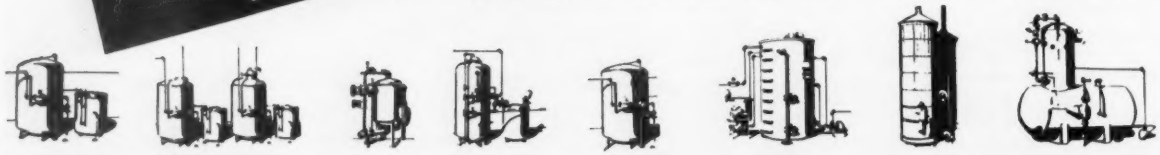
Yes, a difficult field; a field with too many complexities, too many pitfalls, for the "Johnny-come-lately". And this is just as true of the simplest equipment as of the most complex. The equipment may be simple, but anyone who knows the water conditioning field will tell you that the knowledge going into it is far from simple.

The Elgin installations above are poles apart—in form, in purpose, in cost. But they have one thing in common: Thanks to Elgin know-how, they are the best of their kind. And so is "everything in between" when it's Elgin!

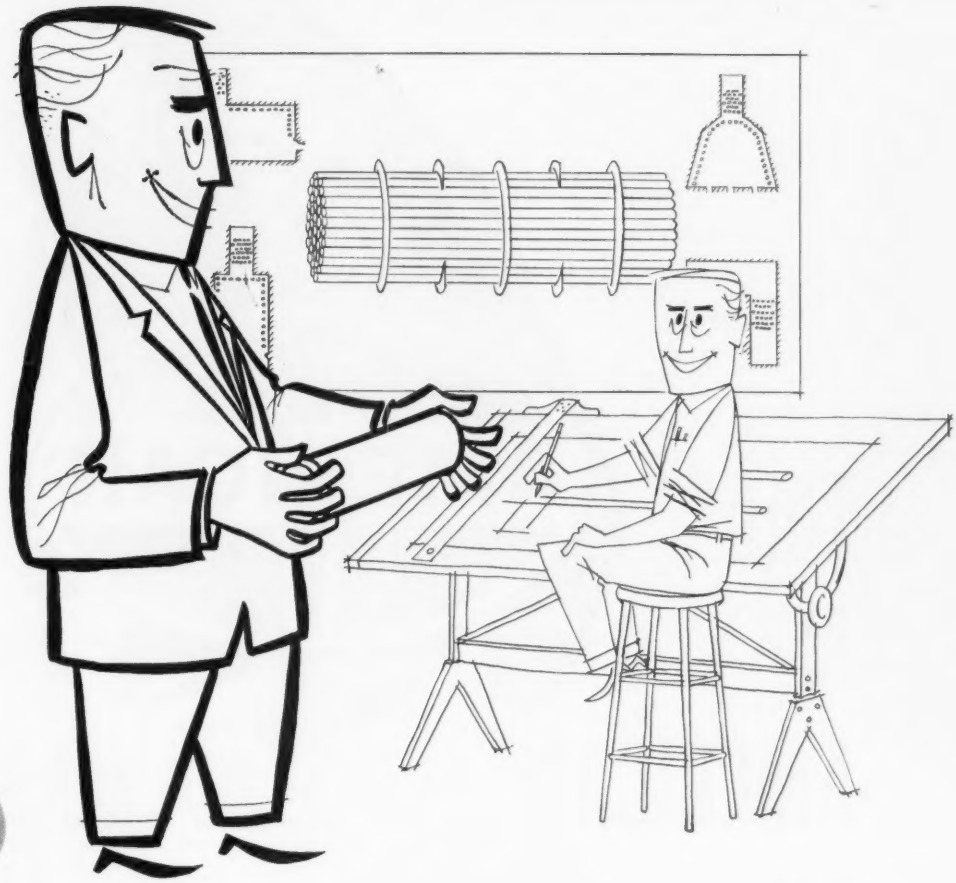
Write for Bulletin 615 covering the scope of Elgin experience. Our nearby representative can put Elgin experience to work on your specific requirements from simplest to most complex.

ELGIN
WATER CONDITIONING
SINCE 1908

ELGIN SOFTENER CORPORATION
130 North Grove Avenue, Elgin, Illinois
Representatives in Principal Cities • In Canada: G. F. Sterne & Sons Ltd., Brantford



SOFTENERS | ION EXCHANGERS | FILTERS | DEIONIZERS | DEALKALIZERS | CLARIFIERS | DEGASITORS | DEAERATING HEATERS



YOU LIFT DESIGN RESTRICTIONS, RAISE HEAT TRANSFER EFFICIENCY

with B&W Job-Matched Stainless and Alloy Steel Pressure Tubing

High pressures—severe temperatures—exposure to oxidation and corrosion—whatever extreme service conditions govern your heat transfer equipment, B&W can produce the right tube for the job.

To give you design freedom, B&W offers a complete selection of stainless and alloy steel pressure tubing. B&W will work closely with you in selecting the right grade and type — in matching the proper tolerances, properties, length, finish and heat treatment to your application. The result: tubing to "spec" that delivers maximum rate of heat transfer, provides easier fabrication and long service life.

Why not talk with B&W while your plans are on the drawing board? Just call your local B&W District Sales Office. Meanwhile write for Bulletin T-417. The Babcock & Wilcox Company, Tubular Products Division, Beaver Falls, Pennsylvania.

B&W

THE BABCOCK & WILCOX COMPANY

TUBULAR PRODUCTS DIVISION

TA-1006-P

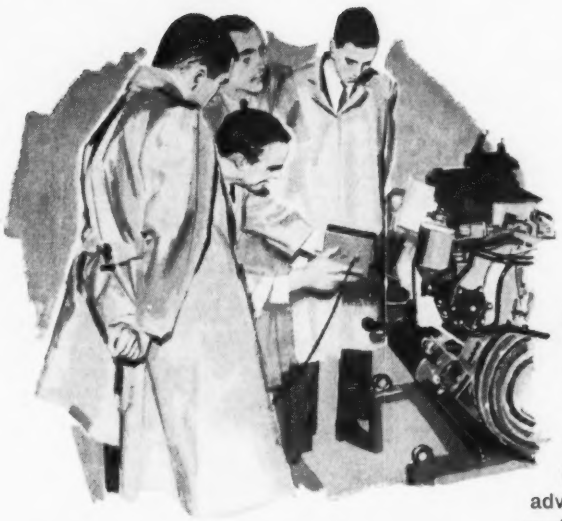
Seamless and welded tubular products, solid extrusions, rolled rings, seamless welding fittings and forged steel flanges—in carbon, alloy and stainless steels and special metals

For more facts circle 216 on Reader Service card, p 103

This is AMERICAN OIL COMPANY

AMERICAN

A sales organization especially trained to serve industrial and fleet customers . . . 74 District Offices and 13 Regional Offices . . . 4,100 warehouses and distribution points . . . 12 refineries . . . more than 2,000 products to serve you . . . this is American Oil Company.



The American Oil Company representative who calls on you receives special training in servicing industrial and fleet customers at our Sales Engineering School. His training begins with a concentrated course in petroleum product quality and application. According to a planned schedule, he returns for an advanced course and then again for post-graduate work. From our Marketing Technical Service Department, your American Oil representative draws assistance, when needed, from specialists who are recognized authorities in their fields. These specialists may be called in at any time to work with you on your lubrication problems. More than a thousand research scientists and technicians at our research laboratory support the effort of our representative to serve you. Their mission: To help your American Oil representative help you lower your maintenance costs and stretch your maintenance dollars. Learn more about American Oil, its men, its service, its products.

AMERICAN

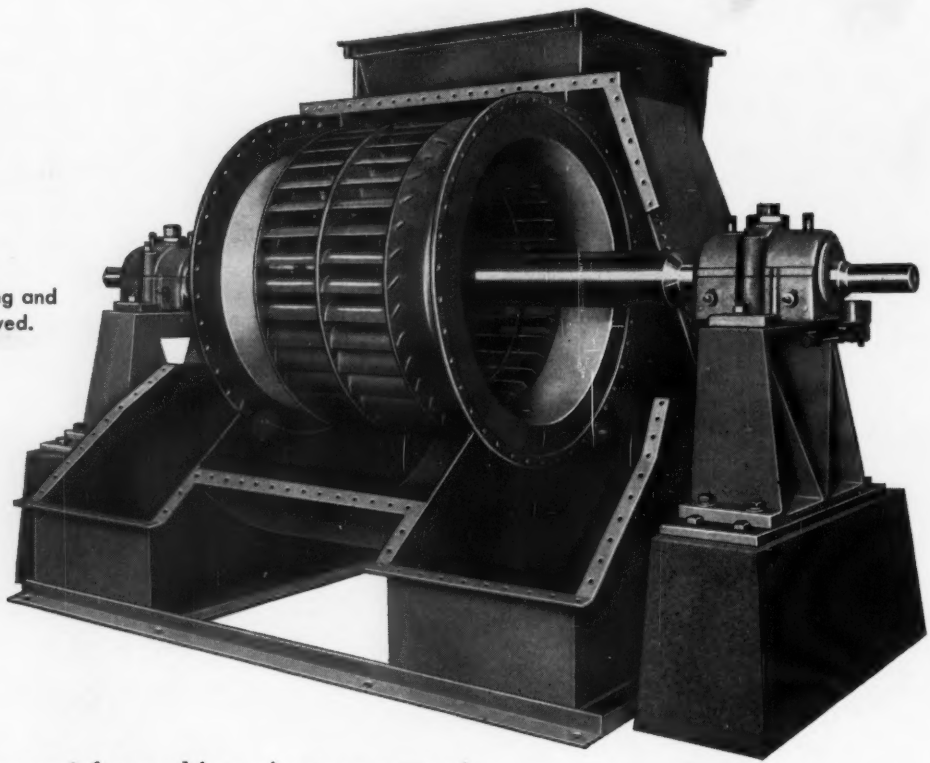
AMERICAN OIL COMPANY

910 S. Michigan Ave., Chicago 80, Ill.

For more facts circle 217 on Reader Service card, p 103

CLARAGE

HAS WHAT IT TAKES for induced draft, toughest fan service of them all! The Clarage Dynacurve Fan is built extra heavy for extra service life. Compact design minimizes floor space and height requirements. Rugged wheel has 36 radially deep, aerodynamically curved blades and tapered rims. Optional wearing plates go where they belong—on the **face,** not the back, of the blades. Optional scroll liners are **bolted,** not welded, for easy replacement. Save cost, save space. Choose Clarage.



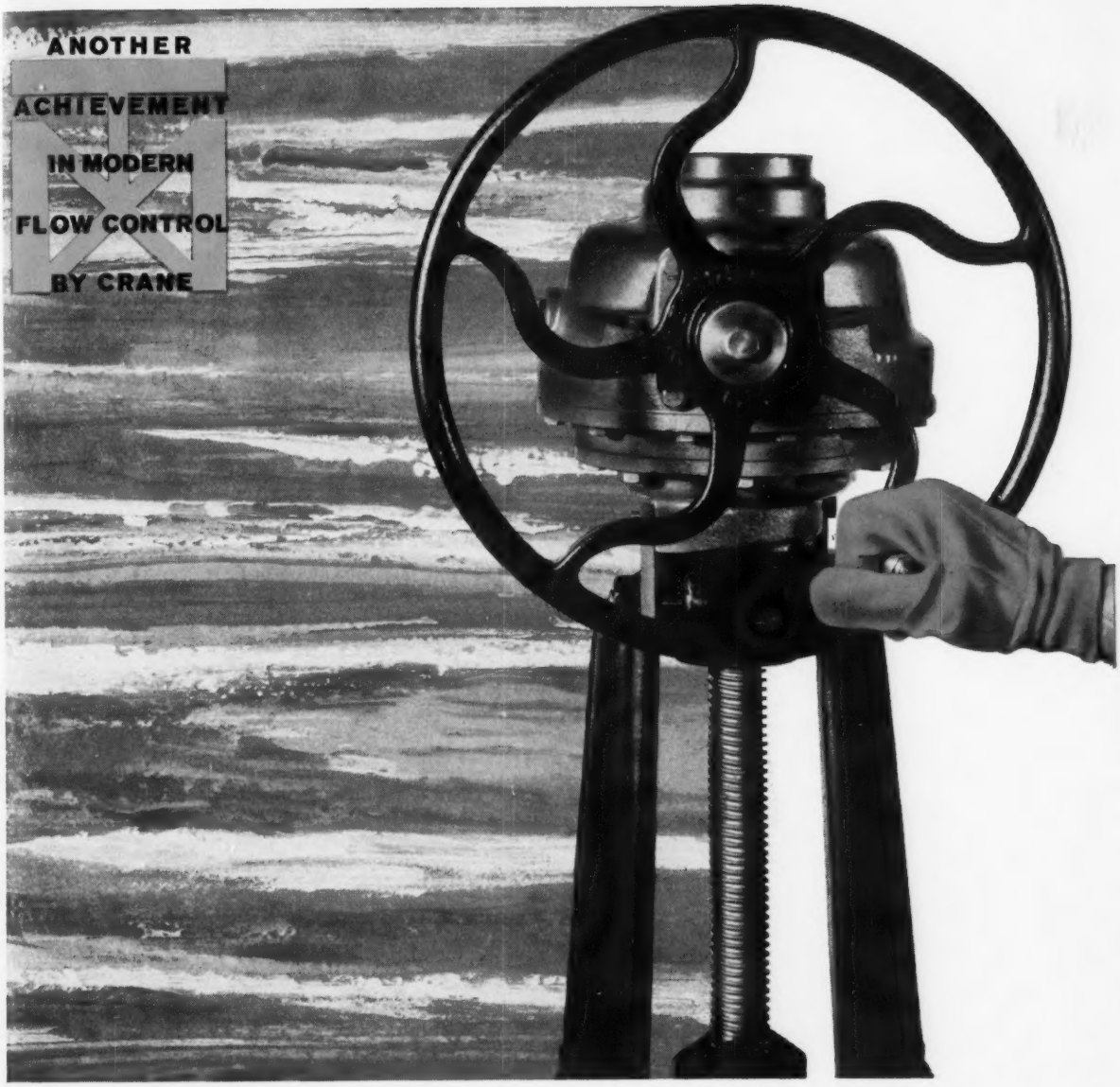
Sections of housing and inlet boxes removed.

Dependable equipment for making air your servant

CLARAGE FAN COMPANY

Kalamazoo, Michigan

SALES ENGINEERING OFFICES IN ALL PRINCIPAL CITIES • IN CANADA: Canada Fans, Ltd., 4285 Richelieu St., Montreal



one hand can stop a river

CRANE'S NEW CONVERTO-GEAR OPERATOR

gives you torque enough to tame a torrent. In a matter of minutes, you can power up a wide range of Crane iron and steel gate valves: OS&Y's with ball-bearing or split yokes, rising and non-rising stem types with stems up to 2½-inch diameter.

Take your choice of two styles—horizontal or vertical wheel—both with spiral-cut bevel gears of carburized alloy steel yielding a 4.11 to 1 ratio in manual operation, or with portable air or electric power. Mechanical efficiency is over 95%, with three sets of ball bearings to cut friction, and the entire self-lubricating unit is rugged and weatherproof.

The kit is complete, for simple installation in less than 30 minutes—or your Crane Distributor can take your order now for new valves already fitted with the power-packed Converto-Gear Operator.

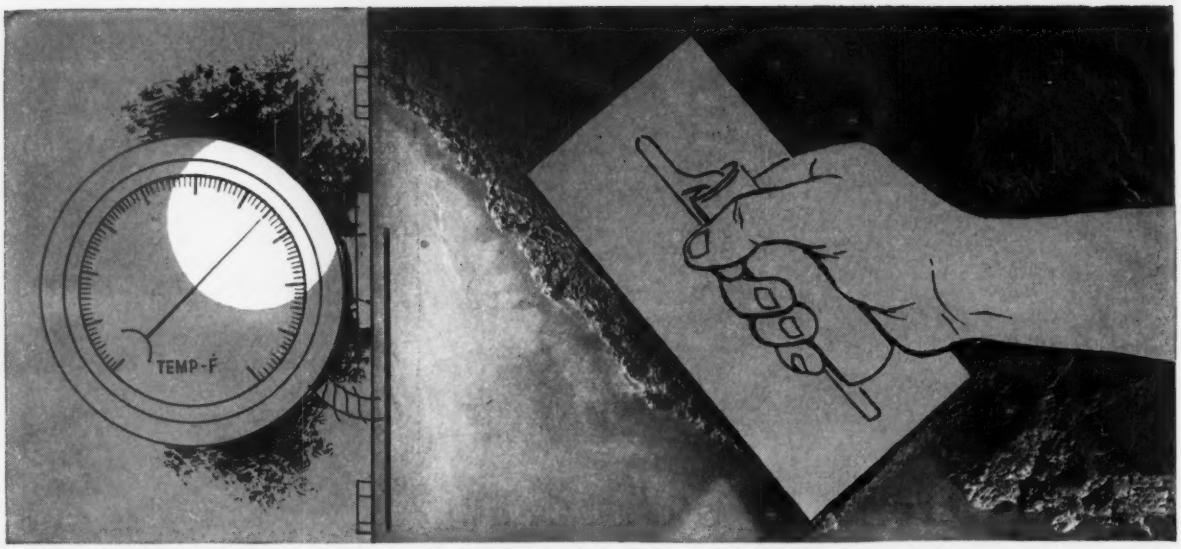
For complete details contact your Crane Distributor or write Crane Co., Industrial Products Group, 4100 S. Kedzie Ave., Chicago 32, Ill. In Canada, Crane, Ltd., 1700 Beaver Hall Square, Montreal.

at the heart of home and industry

CRANE

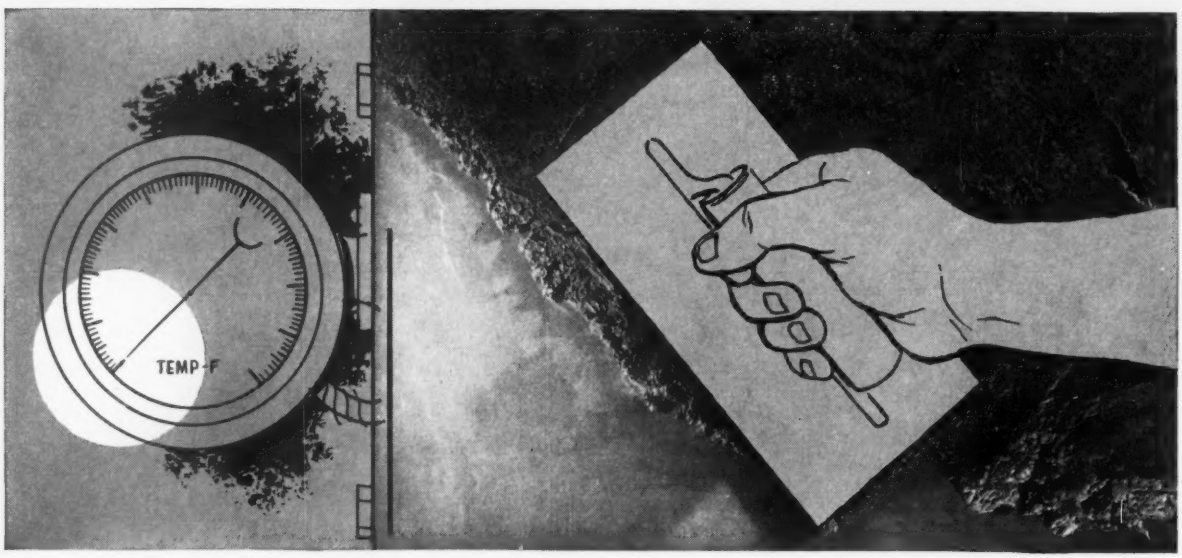
valves
piping • electronic controls
plumbing and heating
air conditioning

For more facts circle 219 on Reader Service card, p 103



IT STICKS TO HOT OR COLD SURFACES!

. . . and it's rust inhibitive!

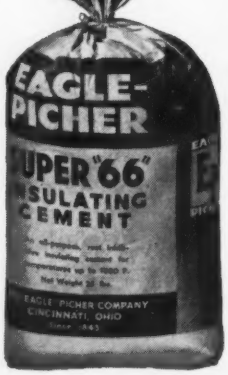


EAGLE-PICHER

SUPER "66"

INSULATING CEMENT

Eagle-Picher produces a complete line of industrial insulations for all temperatures from below Zero to over 2000 F.



Here's why you save money when you use Eagle-Picher Super "66" Insulating Cement

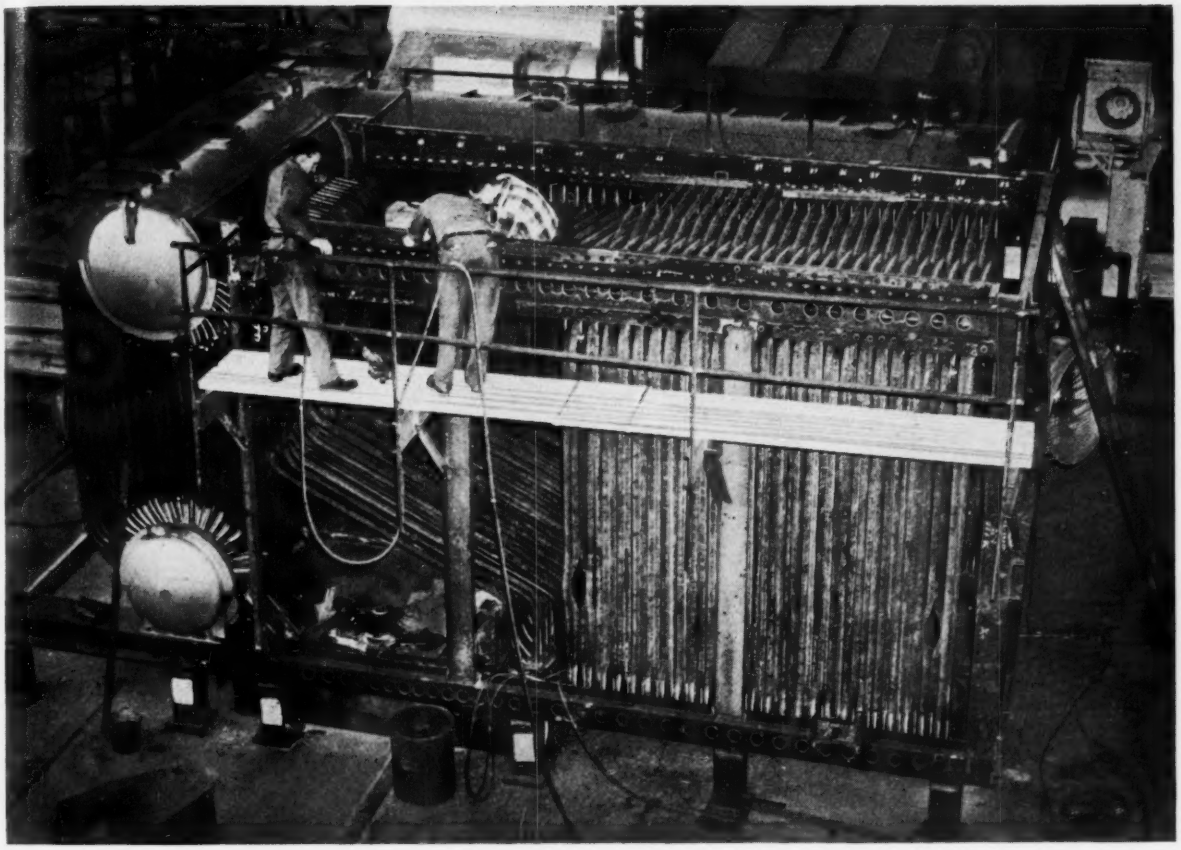
- Because it sticks, Super "66" saves time — applies quickly to any equipment, cold or hot. Effective up to 1800°F. . . . and it contains a special rust inhibitive which actually prevents corrosion !
- Because it sticks, Super "66" saves money— provides far greater coverage and more efficient insulation.
- Because it sticks, Super "66" makes difficult jobs easy—can be used on irregular shapes where application of other insulations is often impossible. Usually requires no reinforcing on applications up to 1½ inches thick.

EAGLE EP PICHER

Since 1843

The Eagle-Picher Company
Dept. P-561
General Offices: Cincinnati 1, Ohio

For more facts circle 220 on Reader Service card, p 103



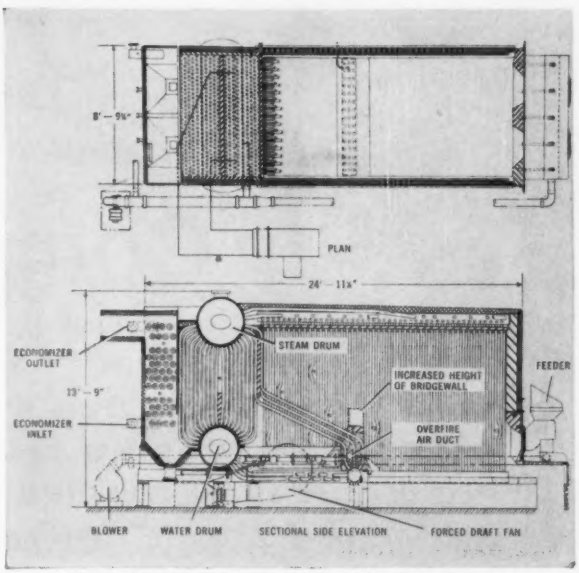
Stoker-fired boiler being shop assembled.

Coal fuels this push-button packaged steam generator

Good news for industry in areas where coal is economical —FW stoker-fired *packaged* steam generators that are comparable with the most advanced gas and oil fired units. Engineered and built with precision, the design has been thoroughly proved and tested in more than two years of operation at full design capacity and above. Performance has been consistently better than expected under all operating conditions.

Units designed for semi-automatic operation are available in three standard sizes: 43,000, 50,000 and 63,000 lb/hr steam capacity at pressures to 250 psig. Push-button control brings these units on or off banked fire. They may be converted to oil firing in a matter of hours. And for easy handling and speedy low-cost erection, they are shipped in three major subassemblies, one of which is the complete boiler and economizer section shown above and at right.

For complete performance and descriptive data on FW stoker-fired packaged steam generators, request bulletin PG59-4. Standard oil and gas fired units are also available in capacities from 13,000 to 100,000 lb/hr. Foster Wheeler Corporation, 666 Fifth Avenue, New York 19, New York.



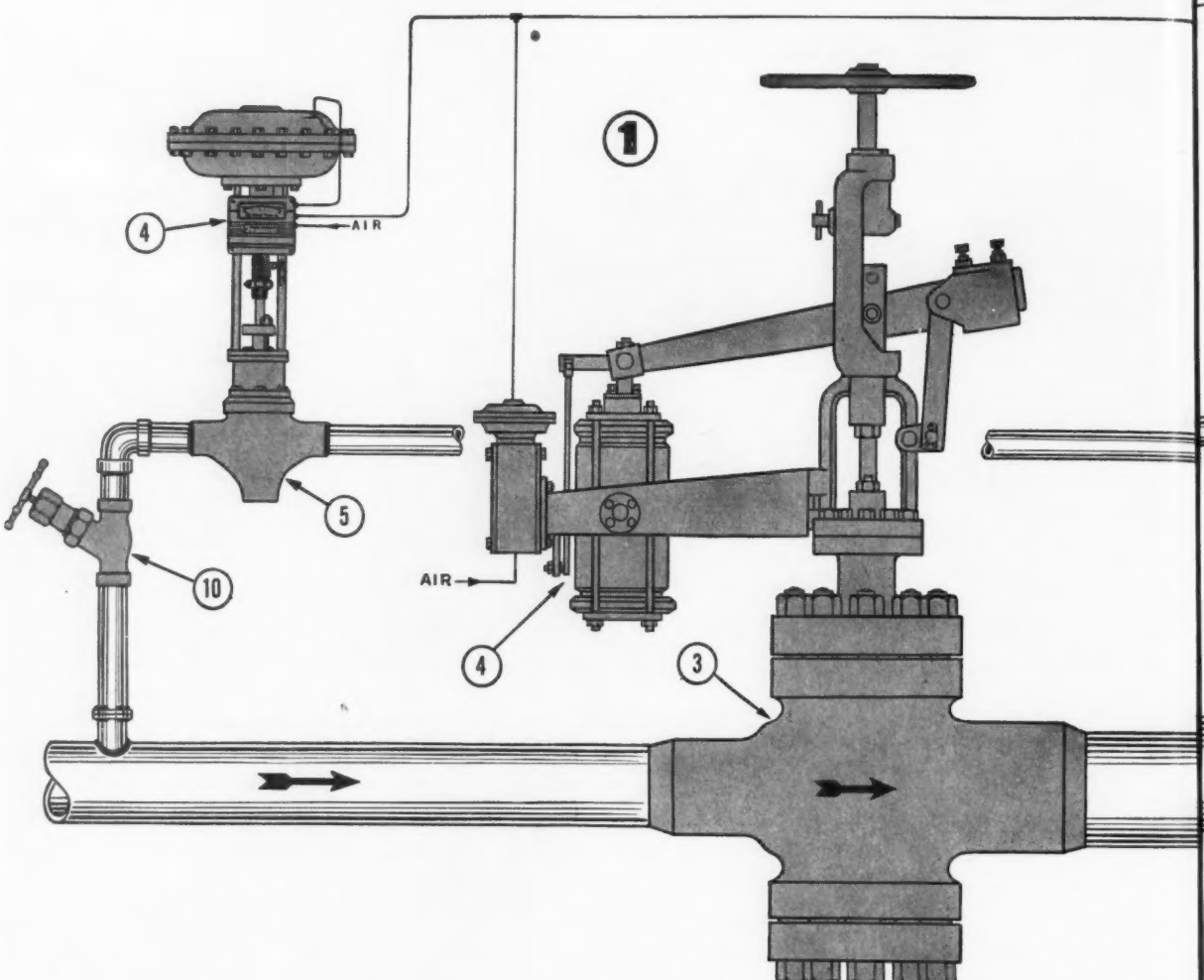
Heat Engineered products, plants and processes . . . for the world's industrial progress.

FOSTER WHEELER

NEW YORK TORONTO LONDON PARIS MILAN TOKYO

For more facts circle 221 on Reader Service card, p 103

Pressure Reducing and



Complete package

① SYSTEM ENGINEERING BY _____

② STEAM ATOMIZING DESUPERHEATER BY _____

③ PRESSURE REDUCING VALVE BY _____

④ POSITIONERS AND DRIVE UNITS BY _____

⑤ ATOMIZING STEAM CONTROL VALVE BY _____

⑥ WATER FLOW CONTROL VALVE BY _____

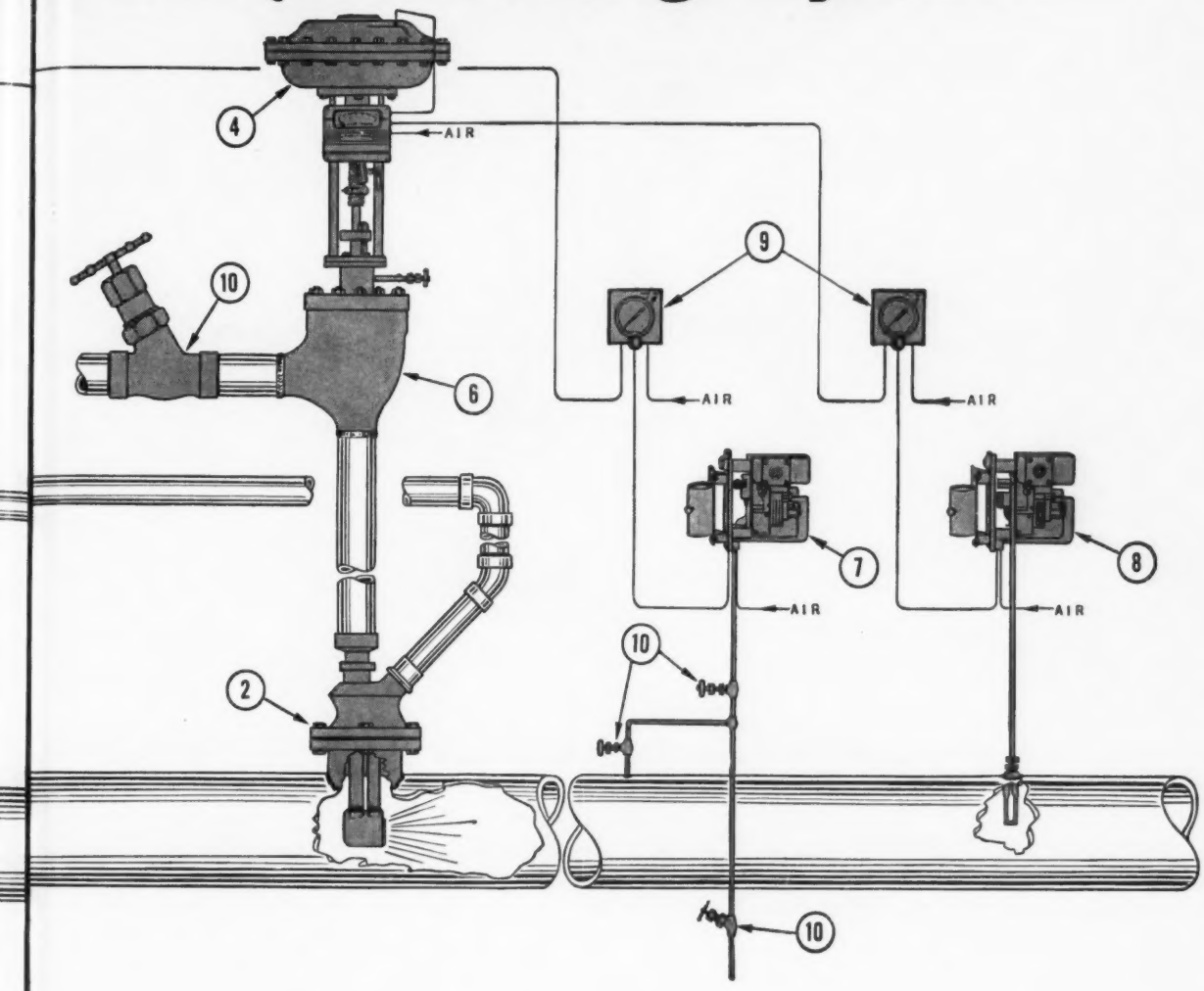
⑦ PRESSURE CONTROLLER BY _____

⑧ TEMPERATURE CONTROLLER BY _____

⑨ CONTROL STATIONS BY _____

⑩ STOP AND BLOW-DOWN VALVES BY _____

Desuperheating System



from one source:

ROCKWELL-REPUBLIC
ROCKWELL-REPUBLIC
ROCKWELL-REPUBLIC
ROCKWELL-REPUBLIC
ROCKWELL-REPUBLIC
ROCKWELL-REPUBLIC
ROCKWELL-REPUBLIC
ROCKWELL-REPUBLIC
ROCKWELL-REPUBLIC
ROCKWELL-EDWARD

For full details on how a Rockwell-Republic pressure reducing and desuperheating system can benefit you, contact the Republic Engineer in your area. Or, write to Republic Flow Meters Company, Subsidiary of Rockwell Manufacturing Company, 2240 Diversey Parkway, Chicago 47, Illinois. In Canada: Republic Flow Meters Canada Ltd., Toronto.

REPUBLIC INSTRUMENTS AND CONTROLS
more fine products by
ROCKWELL

For more facts circle 222 on Reader Service card, p 103

Specimens of copper powders, balls and balled sheets which can be removed from high-pressure boilers by the M-71 treatment.

M-71 REMOVES THESE COPPER TROUBLEMAKERS FROM BOILERS, FAST!

The M-71 single-stage, patented treatment* for high-pressure boilers removes copper deposits and other scales in record time. With this exclusive Dow Industrial Service treatment, copper does *not replate* on clean boiler surfaces during treatment, and small quantities of M-71 in future cleaning will help *keep* boilers copper-free. To date, the M-71 treatment has cleaned more than 300 boilers.

Copper deposits, common in many high-pressure boilers, reduce heat transfer efficiency and cause localized corrosion, overheating and subsequent ruptures. Copper particles slough off, reducing circulation.

Dow Industrial Service developed the M-71 treatment to remove troublemaking copper and other deposits at the same time. In cases of excessive metallic copper deposits, a preliminary treatment may be desirable.

D.I.S. cleans all kinds of equipment . . . boilers, process equipment, pipelines, water wells, to name a few . . . for every kind of industry. With many methods to choose from, D.I.S. engineers first analyze each job to pick the technique best suited to the specific problem.

D.I.S. also offers complete consulting laboratory service for water treatment and waste processing, backed by the technical resources of The Dow Chemical Company. For fast "total" cleaning of any industrial equipment, anywhere in the U.S.—and for literature on copper removal by the M-71 treatment—write or call DOW INDUSTRIAL SERVICE, 20575 Center Ridge Road, Cleveland 16, Ohio.

*Patent No. 2959555

DOW

DOW INDUSTRIAL SERVICE • Division of The Dow Chemical Company

For more facts circle 223 on Reader Service card, p 103

For more facts circle 224 on Reader Service card, p 103 ➤

MYTHOLOGY: The Midas Touch changed objects into gold.

TECHNOLOGY: This ore smelter goes Midas one better—by extracting gold, silver, copper and zinc from smoke.

Whether recovery or smoke abatement is the objective, depend upon the performance of Koppers Electrostatic Precipitators.

Koppers—a leading manufacturer of gas cleaning equipment for industry.

**Facts available on request*

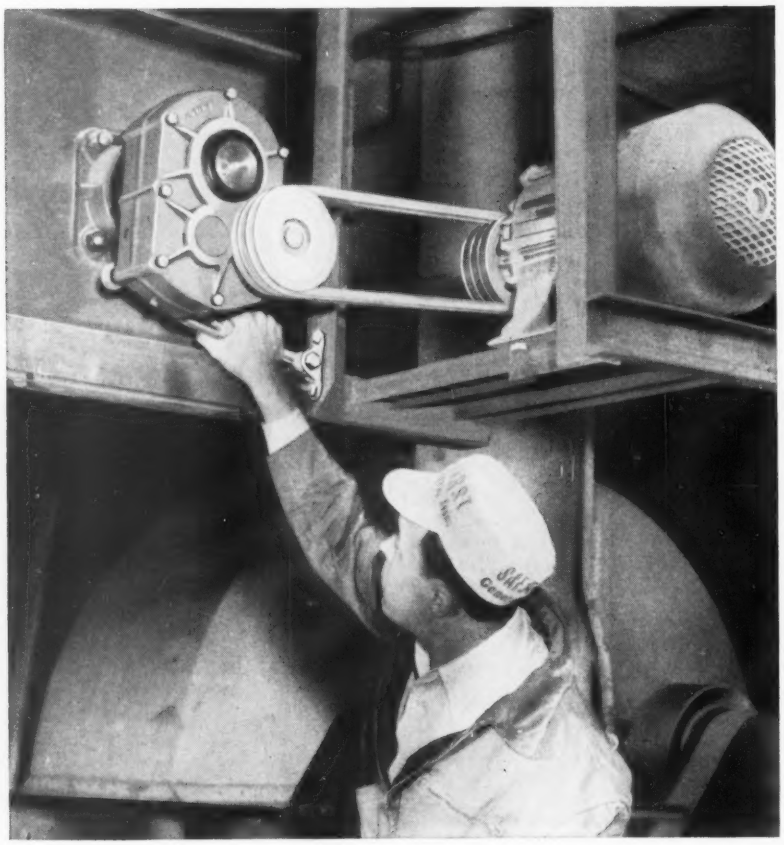
KOPPERS

ELECTROSTATIC PRECIPITATORS

Engineered Products Sold with Service • Baltimore 3, Maryland

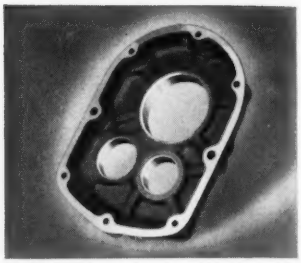
...the quality-engineered package

that simplifies speed reduction

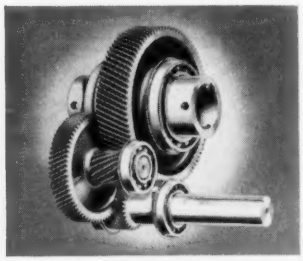


DODGE TORQUE-ARM, America's most widely used shaft mounted speed reducer, will save money for *you.* No foundation, no sliding motor base, no flexible coupling, no installation fuss. Developed and perfected by Dodge, this reducer has been so widely accepted in industry that it is now built and stocked in this unmatched range of sizes and models: capacities up to 170 hp; output speeds from 10 to 400 rpm; ratios of 5:1, 15:1, 25:1; speed ratios up to 175 to 1 with correct selection of speed reducer and V-belt drive. Built-in backstop available. Also positive overload release. Vertical models. Flange mounted models. Special application models . . . Go modern—go Torque-Arm! See your Dodge Distributor, or write us.

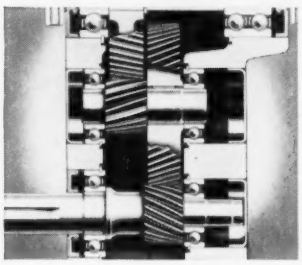
Dodge Manufacturing Corporation, 3200 Union St., Mishawaka, Ind.



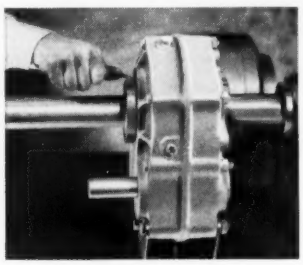
Rugged, semisteel housing holds bearing seats in line for entire life of unit. Laughs at loads. Corrosion resistant.



AGMA rated helical gears. Soft cores withstand shock; hardened surfaces defy wear. Teeth are crown shaved.



Gears are located *between* bearings and carry their loads without strain. Longer life, higher efficiency.



Unit slides completely onto shaft and locks on *both* sides of housing. This baby stays *put*—runs truer longer.

The Products with the Pluses... **DODGE** ***of Mishawaka, Ind.***

CALL THE TRANSMISSIONEER, your local Dodge Distributor. Look under "Dodge Transmissioneer" in the *white* pages of your phone book. Factory trained by Dodge, he can give you valuable assistance.

11,400 KW Organic Moderated Reactor plant for the City of Piqua, Ohio

The Peaceful Atom

Answering the challenge of the Sixties: to double the world's power output in ten years

To meet increased living standards everywhere, the world's power resources must be doubled in the 1960's. In this great expansion the Peaceful Atom will play an ever-increasing role. Atomics International, a leader in developing nuclear power for over 15 years, is already building two of the world's most advanced power stations under AEC programs: the Organic Reactor plant at Piqua, Ohio and the Sodium Reactor plant at Hallam, Nebraska. Another promising concept is the Advanced Epithermal Thorium Reactor project, now being developed by AI for the Southwest Atomic Energy Associates, a group of investor-owned utilities. AI's experience and facilities will play a growing part in meeting the power challenge of the Sixties.

ATOMICS INTERNATIONAL

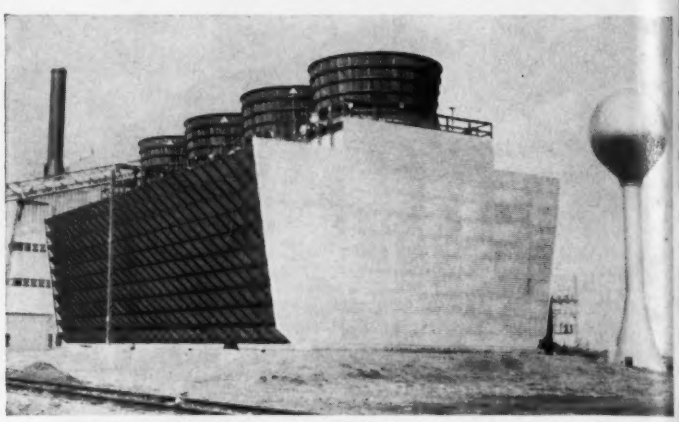
Division of North American Aviation

Pioneers in the creative use of the atom

World Headquarters: Canoga Park, California, U.S.A. Cable Address: ATOMICS. *Other offices:* Washington, D.C., U.S.A.; Geneva, Switzerland. *Affiliated with:* INTERATOM, Bensberg/Cologne, Federal Republic of Germany and DYNATOM, Paris, France

As a matter of public record, here are Marley's

1960 TOWER TESTS



This Class 600 Double-Flow is typical of towers tested (see Test No. 12)

Again Marley is pleased to present its "annual report" to industry—the consecutive results of all acceptance tests* of Marley industrial cooling towers made in 1960. This series of tests demonstrates that The Marley Company is adhering rigidly to its established policy that every cooling tower proposed shall have ample capacity to perform in accordance to purchaser's specifications . . . after compensating for every contingency that may affect operating conditions. Every plant or process served by these Marley towers operated with specified cooling capacity from start-up date; no delays for alterations or additions were experienced by any of these Marley customers.

Test No.	TYPE OF SERVICE AND LOCATION	SPECIFIED CONDITIONS				TEST RESULTS[2]	
		Gallons Per Minute	Hot Water Temp.	Cold Water Temp.	Wet Bulb Temp.	Degrees[1] Cold Water Temp.(F°)	Percent Capacity
1	Generating Station—Gulf Coast	20,000	102.0	87.0	80.0	+0.6°	+10.8
2	Generating Station—Southwest	58,000	105.2	86.0	70.0	+1.6°	+9.7
3	Generating Station—South	1,700	111.5	95.0	80.0	+0.8°	+4.8
4	Generating Station—South Central	800	105.5	90.0	76.0	+0.9°	+7.0
5	Generating Station—Mid-Central	11,850	102.5	90.0	78.0	+1.1°	+8.4
6	Chemical Plant—Northeast	5,100	105.0	85.0	75.0	±0.0°	±0.0
7	Generating Station—Southwest	36,800	102.6	81.3	67.5	+0.6°	+3.8
8	Generating Station—Gulf Coast	116,200	110.7	92.0	76.0	+0.25°	+1.7
9[3]	Petroleum Refinery—Mid-Central	22,500	99.1	85.0	75.0	+0.1°	+0.7
10[3]	Generating Station—Southwest	63,000	106.0	90.0	75.0	±0.0°	±0.0
11	Air Conditioning—Mid-Atlantic	18,000	96.0	86.0	79.0	+0.1°	+1.25
12	Generating Station—Mid-Central	30,000	103.0	87.0	75.0	+0.7°	+5.0
13	Chemical Plant—Mid-South	9,000	102.0	85.0	78.0	+1.0°	+12.7
14	Chemical Plant—Mid-Central	9,200	110.0	80.0	71.0	+0.4°	+3.7
15	Air Conditioning—East Central	4,780	96.5	86.5	80.0	+0.85°	+10.6
16	Air Conditioning—East Central	2,940	98.8	82.7	78.0	+0.34°	+6.5
17	Air Conditioning—East Central	7,500	95.0	85.0	78.0	+0.3°	+2.45
18	Petroleum Refinery—South Central	10,000	117.0	85.0	76.0	+0.75°	+7.4
19	Generating Station—Mid-Central	26,000	98.0	85.0	75.0	+0.83°	+8.1
20	Generating Station—South Central	61,000	103.5	88.0	78.0	−0.24°	−1.8
21	Air Conditioning—North Central	5,850	99.0	89.0	80.0	+0.8°	+8.7

*Conducted in accordance with procedure specified by ASME Power Test Code, recognized standard for measurement of cooling tower capability.

NOTES: 1. + indicates lower cold water temperature than specified; — indicates higher cold water temperature than specified. 2. Test results adjusted to specified conditions. 3. CTI observer present during test.

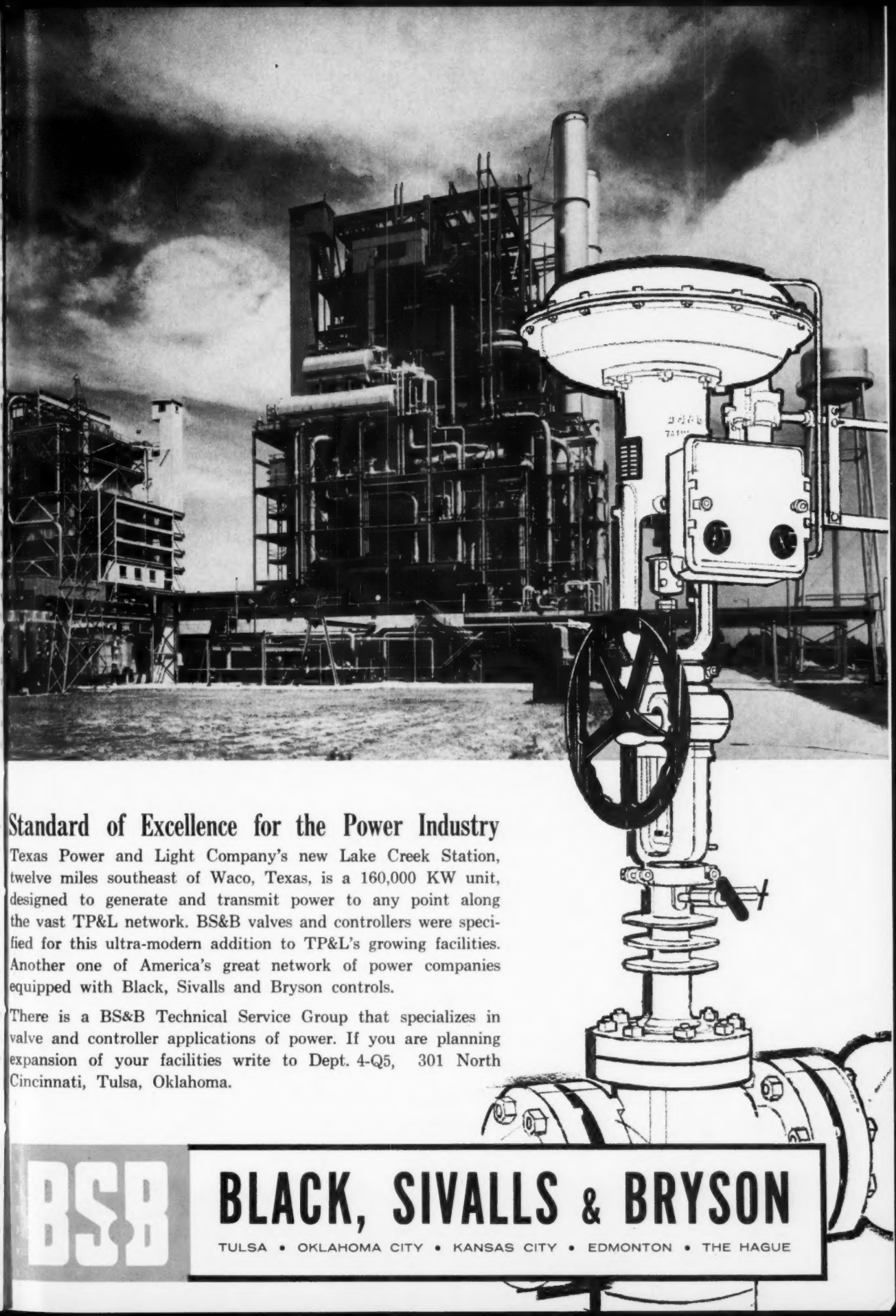
Write for "TEST YOUR TOWER"

A revised edition of this technical publication details the Marley method of tower testing; will enable you to know the capability of your tower. Write direct or ask your nearby Marley engineer for copies for your engineering staff.

THE MARLEY COMPANY ● KANSAS CITY MISSOURI

For more facts circle 227 on Reader Service card, p 103

circle 228 on Reader Service card, p 103 ➤



Standard of Excellence for the Power Industry

Texas Power and Light Company's new Lake Creek Station, twelve miles southeast of Waco, Texas, is a 160,000 KW unit, designed to generate and transmit power to any point along the vast TP&L network. BS&B valves and controllers were specified for this ultra-modern addition to TP&L's growing facilities. Another one of America's great network of power companies equipped with Black, Sivalls and Bryson controls.

There is a BS&B Technical Service Group that specializes in valve and controller applications of power. If you are planning expansion of your facilities write to Dept. 4-Q5, 301 North Cincinnati, Tulsa, Oklahoma.

BS&B

BLACK, SIVALLS & BRYSON

TULSA • OKLAHOMA CITY • KANSAS CITY • EDMONTON • THE HAGUE

TYPE
C10
CYCLO-TRELL

Ammunition for the war on dust!

Fighting dust is the purpose of this load of Cyclo-trell C10 "shells." ■ Cyclo-trell units for process gas or air cleaning in steel mills, refineries, paper, cement or chemical plants give you high efficiencies. ■ Engineered to fit each specific job, Cyclo-trell units are available in a wide range of sizes and types including C10, C24, IC (Involute Cyclo-trell) and ICL (Involute Cyclo-trell, Lined). ■ Why not let us consult with you on your specific dust collection problems? For further information, write for Bulletin 300 which describes several applications in detail.

Research-Cottrell

RESEARCH-COTTRELL, INC., Main Office and Plant: Bound Brook, N. J.
Representatives in principal cities of U.S. and Canada

RESEARCH COTTRELL INC ®

RC-309

(Advertisement)

Why a Steam Trap Has to Handle "Air"

Low temperatures and corrosion of equipment are often evidence of inadequate trap air venting capacity

Air, with its load of oxygen and carbon dioxide, has an unwholesome habit of interfering with the efficiency of steam heated units. If steam were always free of these undesirable companions, things would be a lot simpler for men-who-operate-plants. Because it isn't, three unhappy situations frequently occur:

1. ***Operating temperatures are subnormal.*** This is a two-part problem. First, an air-steam mixture has a lower temperature than pure steam at the same pressure—see Table A. Secondly, air can "plate out" on heat transfer surfaces as shown in Figure 1. Under some conditions, such an air film will knock down heat transfer efficiency by as much as 50%.

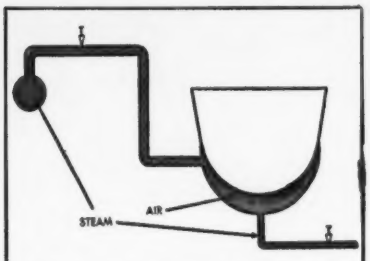


Fig. 1. *How air can "plate out" on heat transfer surfaces. This "insulation" drastically reduces heat transfer efficiency. Armstrong trap operation creates turbulence in the equipment that prevents this.*

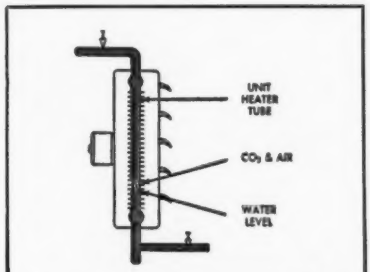


Fig. 2. *Corrosion occurs when units are not kept continuously free of both condensate and air. Armstrong traps discharge both,* at steam temperature, *as fast as they accumulate.*

2. ***Corrosion rears its ugly head.*** Oxygen and carbon dioxide are real trouble-makers. CO_2 gas goes into solution in condensate, forms carbonic acid and chews away at vulnerable metal sections. O_2 aggravates situation. See Figure 2.

TABLE A—How air reduces steam temperature.

Gauge Pressure	Temp. of Steam with No Air Present	Temp. of Steam Mixed With Various Amounts of Air (% Air by Volume)	
		10%	30%
10.3	240.1	234.3	220.9
25.3	267.3	261.0	246.4
50.3	298.0	291.0	275.1
75.3	320.3	312.9	295.9
100.3	338.1	330.3	312.4

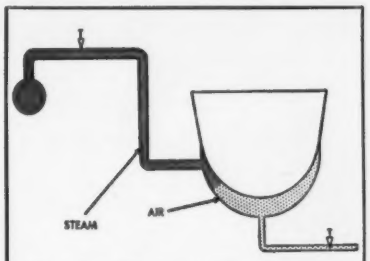


Fig. 3. *When steam is turned on, it takes a trap with extra air venting capacity to provide fast heat-up.*

3. ***Heat-up is slow as a snail.*** Air has a picnic in units that are shut off periodically. Figure 3 pictures the problem. Lines and equipment literally fill up with air. When the steam is turned on it can get in only as fast as the air gets out.

Enter Steam Traps

Curing these steam system ailments involves an operation sometimes called a "trap transplant." It consists of removing traps that don't get the air out and replacing them with traps that do.

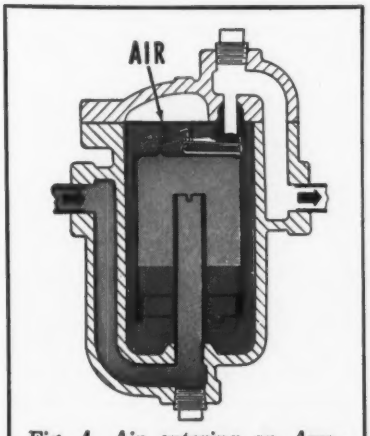
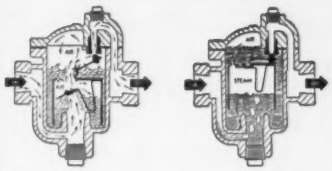


Fig. 4. *Air entering an Armstrong trap passes through the bucket vent and accumulates in the top of trap. When trap opens, air is discharged along with condensate.*

Figure 4 shows how an Armstrong inverted bucket trap continuously vents air. What the picture doesn't show is a built-in plus-value of this trap's design. An Armstrong trap opens suddenly, creating a momentary pressure drop and turbulence in the unit being drained. This breaks up air films and "pumps" air down to the trap so it can be vented.

The vents in standard Armstrong trap buckets will pass all the air normally encountered. In special cases, such as paper machine dryers, the vents are correctly sized larger at the factory to meet the requirement.



Thermostatic vent open. *Thermostatic vent closed.*

Fig. 5. *Open float with thermostatic vent for off-and-on units. When trap is cold, vent is open, permitting air to blow through when steam is turned on. When steam reaches trap, heat closes thermostatic vent. Then, regular bucket vent handles all air coming in with steam.*

Open Float with Thermostatic Vent

Super air-venting capacity is a must for fast heat-up of low pressure unit heaters, heating coils, steam headers and other units that are on-and-off. Figure 5 shows how the Armstrong open-float-with-thermostatic-vent trap takes care of this.

* * *

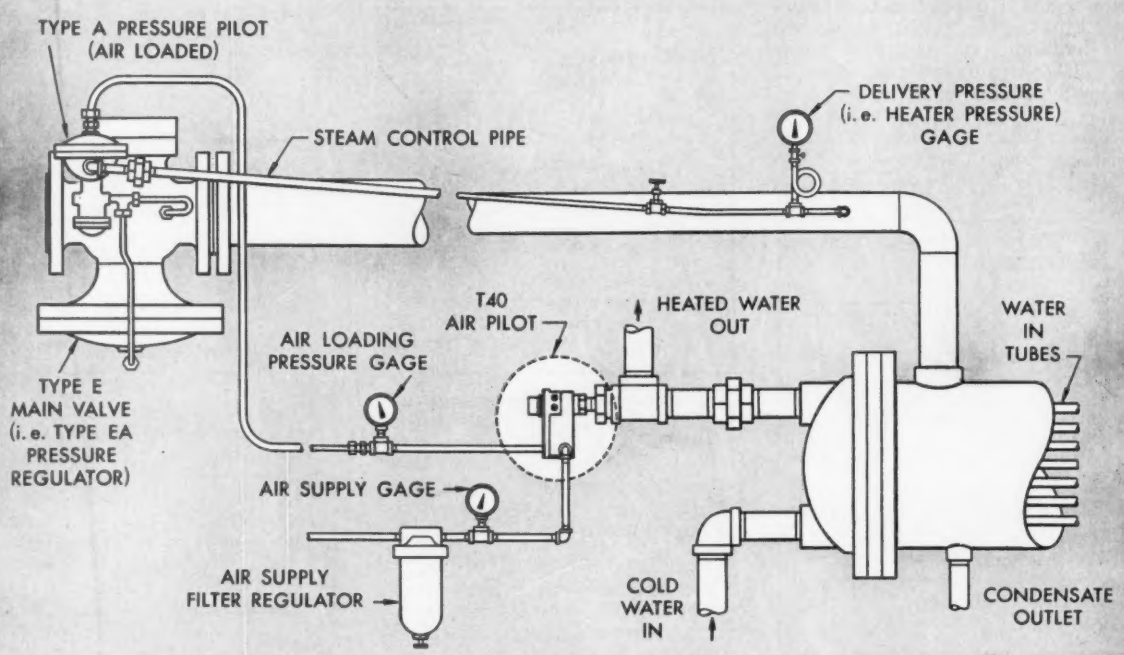
The 44-page Armstrong steam trap book covers other features of the Armstrong trap as well as its excellent air handling characteristics. This catalog also discusses trap selection, installation and maintenance. Your local Armstrong Representative or Distributor will be glad to give you a copy. Call him, or write Armstrong Machine Works, 8127 Maple Street, Three Rivers, Michigan.

ARMSTRONG STEAM TRAPS

See Our Catalog in Sweet's Plant Engineering File

For more facts circle 230 on Reader Service card, p 103

New Spence Temperature Control System Gives Unusual Control Accuracy


TYPE A PRESSURE PILOT (AIR LOADED)
STEAM CONTROL PIPE
DELIVERY PRESSURE (i.e. HEATER PRESSURE) GAGE
T40 AIR PILOT
HEATED WATER OUT
WATER IN TUBES
AIR LOADING PRESSURE GAGE
TYPE E MAIN VALVE (i.e. TYPE EA PRESSURE REGULATOR)
AIR SUPPLY GAGE
AIR SUPPLY FILTER REGULATOR
COLD WATER IN
CONDENSATE OUTLET

TYPE EAT40 AIR-CONTROL TEMPERATURE REGULATOR (Patent Pending)

In a recent installation the new Spence air-control temperature regulating system provided:

- ±5°F control accuracy under wide and instantaneous load swings of 210 to 80 gallons per minute.
- Up to 50% reduction in cost as compared to instrument systems of similar accuracy.

This unique cascade-type control with throttling range adjustment independent of maximum heater pressure was developed to meet today's demand for greater control accuracy.

Additional features of the new Spence Temperature Control System include:

- 200°F wide adjustable temperature range
- Adjustable speed of steam pressure change
- Over and under temperature protection
- Pressure limit control
- Fast response
- Very low air consumption
- Field reversible for heating or cooling

The Spence Type EAT Air Control Temperature System, when properly installed, will tame wide ranging, fast changing loads of instantaneous heaters and modern heat exchangers. The cascade principle plus the use of an extremely fast responding bi-metal temperature sensing element reduce time lags and provide control stability.

Here's how the new Spence system operates:

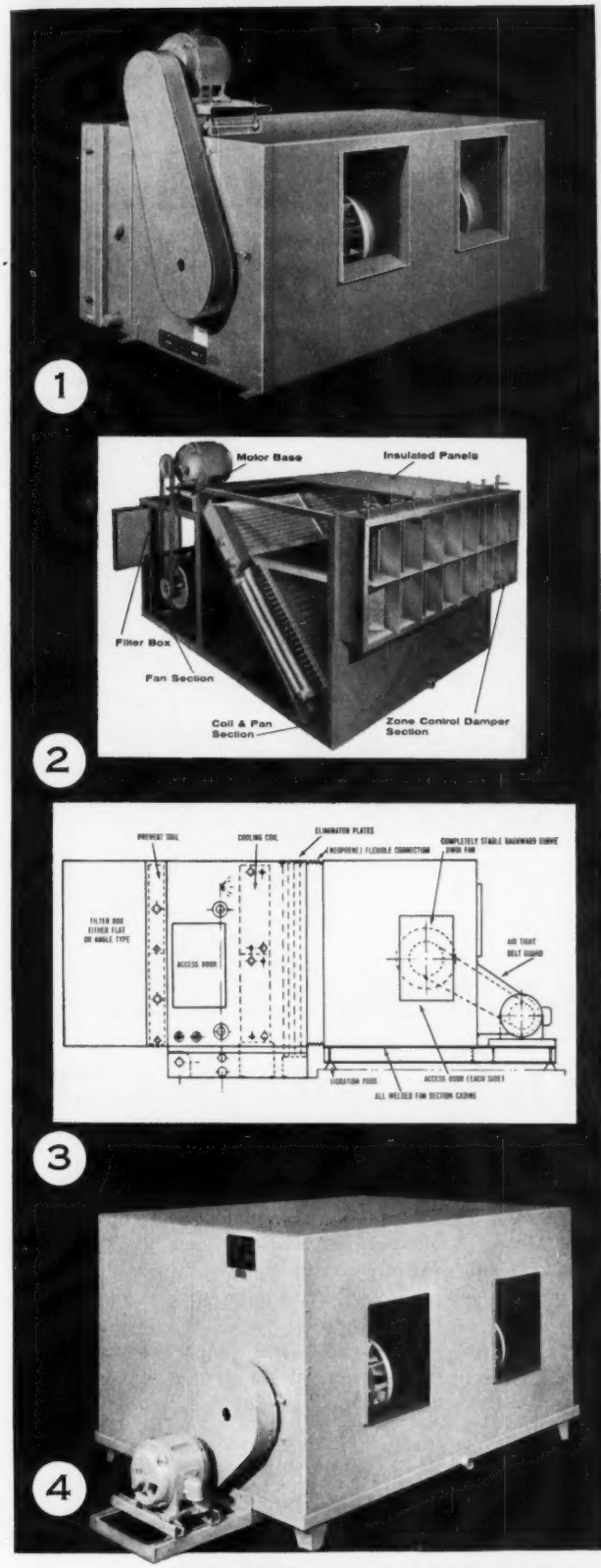
Quick response is based on a bi-metal temperature sensing element. Temperature pilot continuously regulates a loading air pressure.

This loading signal, when applied to a pressure regulator to reflect heater temperatures, causes it to adjust the main valve as changes in load require.

Spence has also developed a new pressure control system based on this same cascade principle. This system has a control accuracy of ½ psi or better from positive pressures through the vacuum range to 30" Hg.

For complete information on these new air controlled temperature and pressure control systems, write for your copy of Bulletin 9.

SPENCE ENGINEERING COMPANY, INC.
Walden 1, New York SE-140



BE REALLY SURE!

Air conditioning performance proved beyond question!

Complete selection to meet specifications exactly!

Start with your simplest heating and ventilating requirements and proceed to the most complex conduit system. There's a 'Buffalo' Cabinet or combination of cabinets to deliver the exact air conditions called for in the plans. 'Buffalo' continues to develop new equipment to meet the most rigorous demands. You are assured of performance-as-specified whenever you write 'Buffalo' into the plans.

Check these quality 'Buffalo' engineering features:

- 'Buffalo' Fans with oversize hollow shafts for vibrationless operation. Backward curved blades for completely stable performance. Limit-Load horsepower characteristic for positive overload protection.
- Heavy-gauge panel casings, galvanized and primed. Rigid, husky frames.
- Quality Aerofin coils for efficient heat transfer and long, trouble-free life.
- Vertical or horizontal installation.
- Many options — filter sections, mixing boxes, dampers and 'Buffalo' 45° and 90° stationary or adjustable outlet elbows.

Your 'Buffalo' Engineering Representative can give you complete information on equipment for any application.

1 For Heating and/or Ventilating — 'Buffalo' H & V Cabinets.

2 For Zone Control Air Conditioning — PCB Cabinets.

3 For High-Pressure Air Conditioning — PCHW Cabinets.

4 For Full Central Station Air Conditioning — PC Cabinets.

BUFFALO FORGE COMPANY

Buffalo, New York

Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

'Buffalo' Air Handling Equipment to move, heat, cool, dehumidify and clean air and other gases.

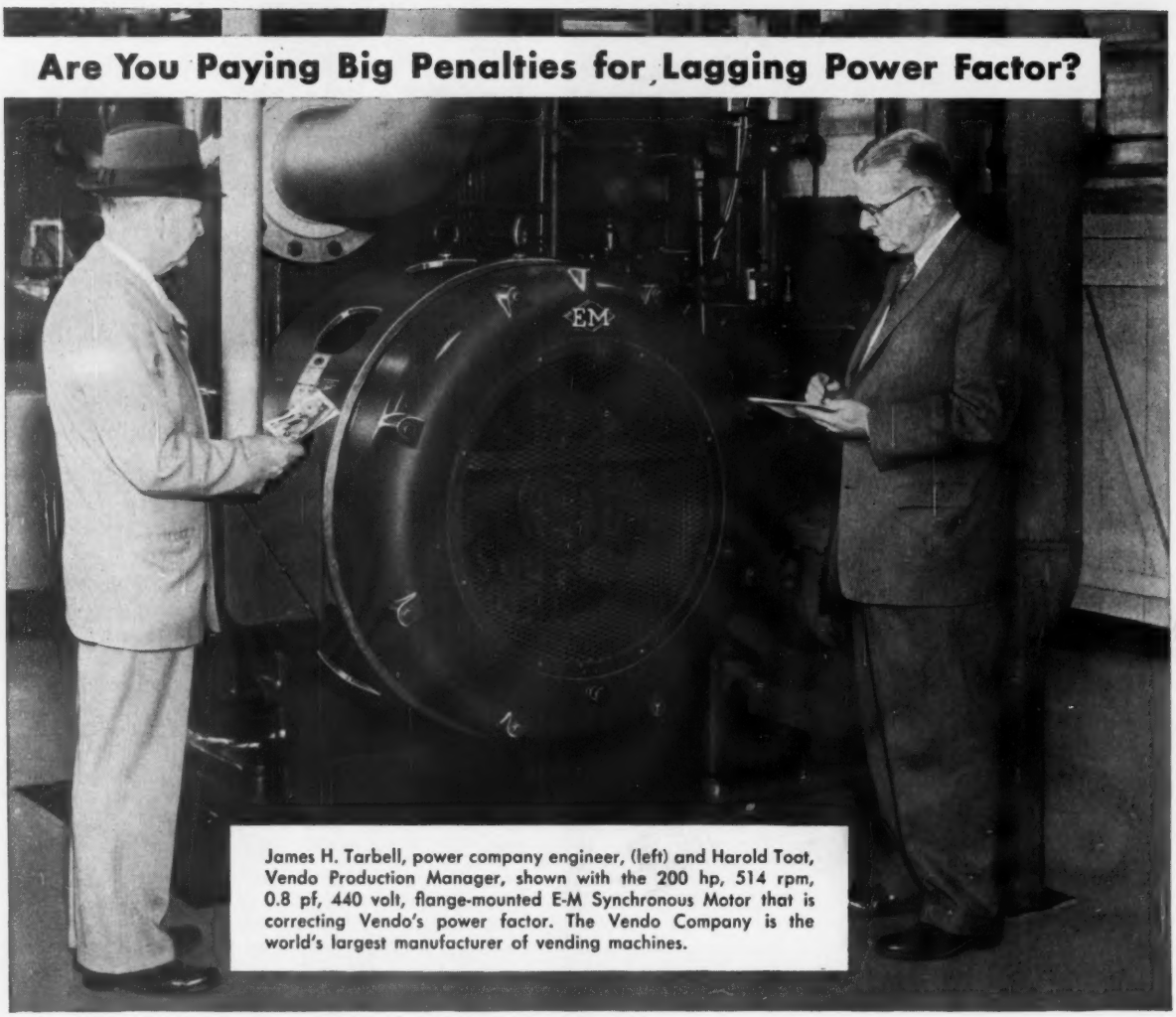
'Buffalo' Machine Tools to drill, punch, shear, bend, slit, notch and cope for production or plant maintenance.

'Buffalo' Centrifugal Pumps to handle most liquids and slurries under a variety of conditions.

Squier Machinery to process sugar cane, coffee and rice. Special processing machinery for chemicals.

For more facts circle 232 on Reader Service card, p 103

Are You Paying Big Penalties for Lagging Power Factor?



James H. Tarbell, power company engineer, (left) and Harold Toot, Vendo Production Manager, shown with the 200 hp, 514 rpm, 0.8 pf, 440 volt, flange-mounted E-M Synchronous Motor that is correcting Vendo's power factor. The Vendo Company is the world's largest manufacturer of vending machines.

Vendo Company Corrects Power Factor... SAVES $450 A YEAR! with an E-M Synchronous Motor

The Vendo Company, Kansas City, Missouri learned its plant was operating at a lagging power factor condition when expanded production facilities required more compressed air. A study by Vendo's engineers and Kansas City Power & Light Company showed an 0.8 leading power factor synchronous motor compressor drive would save them money. Here's how:

Vendo's power contract provides a penalty of 20 cents a month for every reactive kva exceeding one-half the maximum kilowatt demand. *This was costing Vendo $33.00 per month, or $396.00 a year!*

A 20 cents a month bonus is granted for every kilovar the reactive demand falls short of one-half the maximum kilowatt consumption. A 200 hp E-M Synchronous Motor with 0.8 pf would provide enough reactive kva for Vendo to operate at a *leading* power factor and earn a monthly credit of $4.60. Vendo's power bill would then be reduced by $37.60 a month, or $451.20 a year!

Vendo installed the recommended E-M Synchronous Motor . . . and has been enjoying a reduced power bill ever since. You, too, can make a big saving in your plant power bill by correcting your power factor with highly efficient E-M Synchronous Motors.

Learn more about Power Factor. Call your nearby E-M Sales Engineer and write for your free copy of the new E-M 24-page brochure, *The ABC of Power Factor.*

E-M

1100-TPA-2107

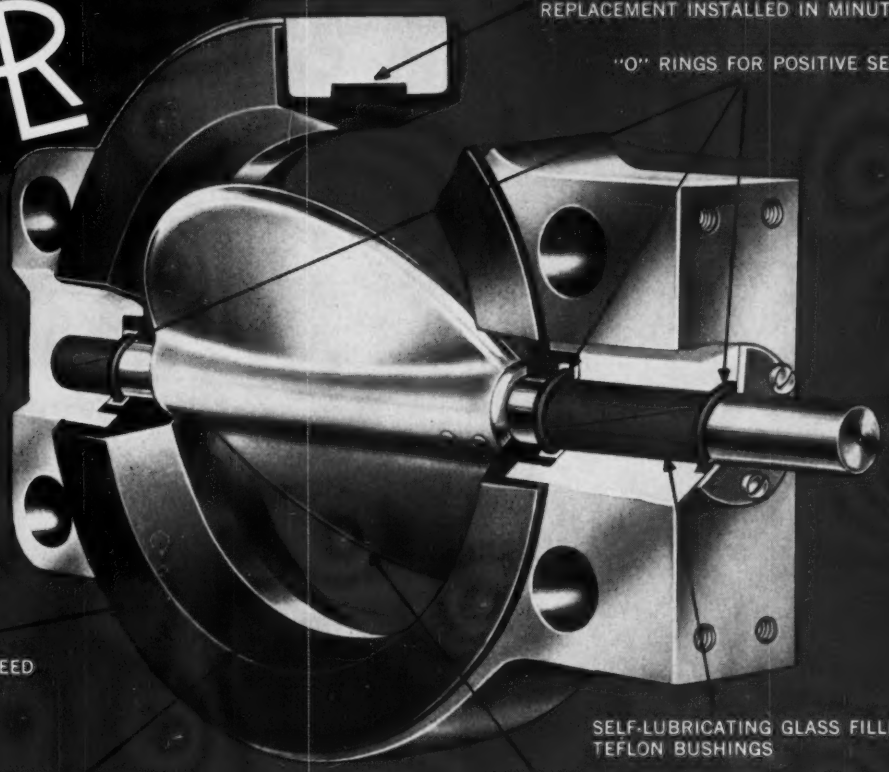
ELECTRIC MACHINERY MFG. COMPANY
MINNEAPOLIS 13, MINNESOTA

Specialists in making motors do
EXACTLY WHAT YOU WANT THEM TO

Now...dependable bubble-tight shutoff

Double R/L

Plus...all of these features


LINER LOCKS WITHIN BODY. SNAP-IN REPLACEMENT INSTALLED IN MINUTES
"O" RINGS FOR POSITIVE SEAL
ELIMINATES NEED FOR GASKETS
SELF-LUBRICATING GLASS FILLED TEFLON BUSHINGS
LINERS AVAILABLE IN A WIDE RANGE OF MATERIALS
DISCS AND BODIES IN ANY CASTABLE ALLOY. SIZES 2" to 12"

The Fisher-Continental *Double R/L* Butterfly Valve

Can be used for on/off or throttling control, using manual and/or power actuators. CONTINENTAL EQUIPMENT COMPANY (a Division of Fisher Governor Company), Coraopolis, Pa.

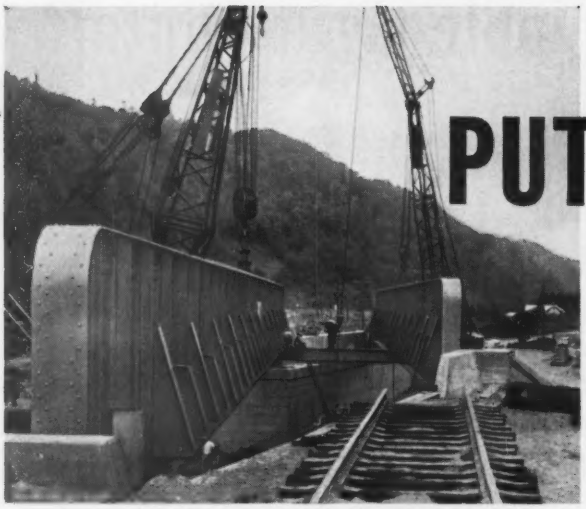
Write for Bulletin 91

If it flows through pipe anywhere in the world ...chances are it's controlled by.....

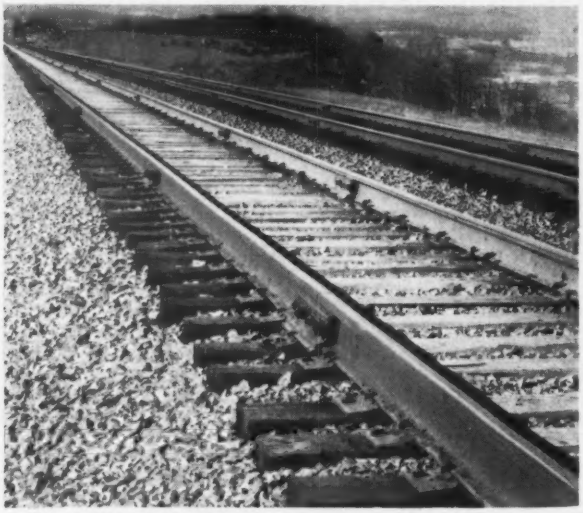
FISHER® Controls SINCE 1880

For more facts circle 234 on Reader Service card, p 103

PUTTING MILLIONS O



One of several links between N&W and merged Virginian, this connection at Kellysville, W. Va., permits use of most favorable grades for faster delivery of coal.



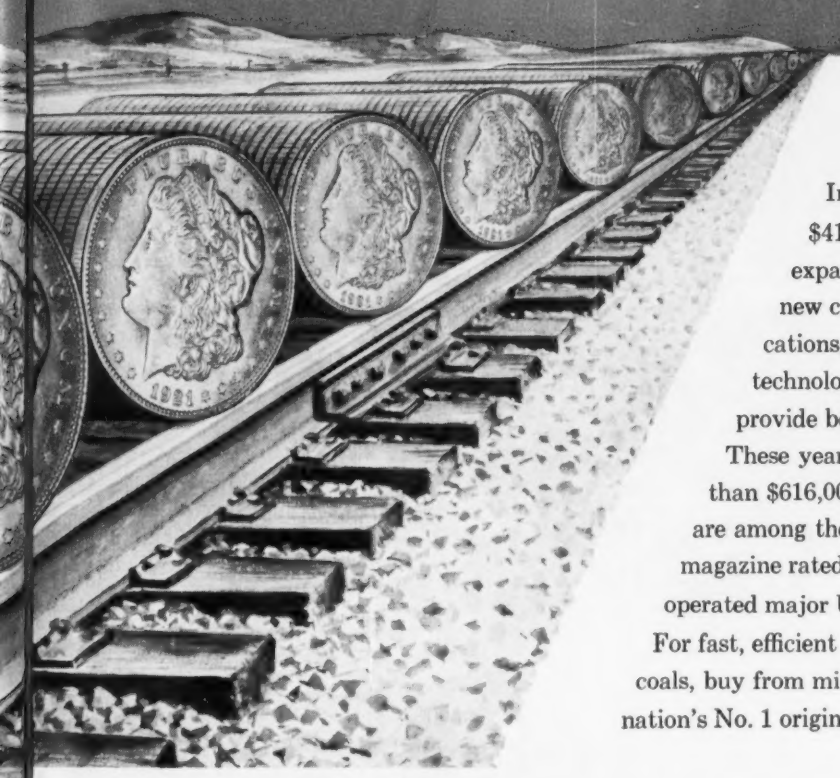
Passing sidings lengthened to accommodate 200-car trains, results in more efficient overall movement of coal.

Installing Centralized Traffic Control on former Virginian speeds greater tonnage of coal over line.

New N&W 85-ton roller bearing hoppers — 1,000 in service and another 1,000 being built — mean faster loading, hauling, delivery and unloading of bigger coal payloads. Nation's newest fleet of locomotives hustles coal movement.

ON THE LINE

To Give You Fast, Efficient Coal Delivery



In 1960, the N&W spent $41,600,000 for new equipment, expanded and improved facilities . . . new cars, new locomotives, new communications, expanded yards, and many other technological and operating advances to provide better service for shippers.

These year after year improvements — more than $616,000,000 since World War II — are among the reasons why a national business magazine rated the N&W the most efficiently operated major U. S. railroad in 1960.

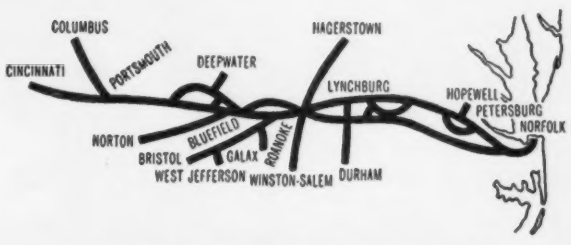
For fast, efficient delivery of superior all-purpose coals, buy from mines located along the N&W . . . nation's No. 1 originator of bituminous coal.

Enlarging and rearranging yards at Roanoke speeds classification of cars and dispatch of trains.

N&W

NORFOLK and WESTERN RAILWAY

GENERAL OFFICES • ROANOKE, VA.



Nation's Going-est Railroad

For more facts circle 235 on Reader Service card, p 103

for the best practical applications for an

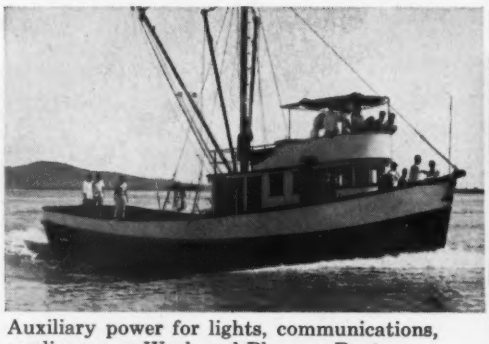
we'll give you

HERE ARE A FEW OF HUNDREDS OF USES FOR ONAN ELECTRIC PLANTS

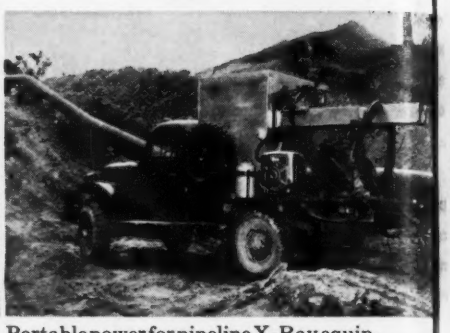
Standby electric power for
Hospitals
Schools
Office Buildings
Homes
Industrial Processes
Greenhouses
Dairy Farms
Hatcheries
Theaters
Stores
Service Stations
Radio & TV Stations
Hotels, Motels
Bridge Lift Gates
Toll Highway Booths
Restaurants
Banks
Military Installations
Resorts
Airport Towers
Microwave for Railroads and Pipeline Distribution
Sewage Disposal
Water Treatment Plants
Iron Lungs

Portable primary power for
Display Vans
Soft Ice Cream Vans
Airport Runway Lighting
Civil Defense Communication
Fire Dept. Lights, Tools
Police Radar, Lights, Communications
Oil Exploration
Mining Equipment
Pipeline Distribution
House Trailers
Magnet Generators
Home Builders, Carpenters
Highway, Dam, Bridge Construction
Electric, Telephone, Gas Utilities
Cemetery Maintenance
Golf Course & Park Maintenance
Electricians
X-Ray Equipment
Bookmobiles

Marine power for
Pleasure Boats
Work Boats



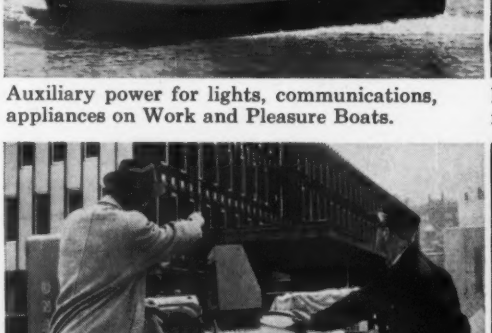
Auxiliary power for lights, communications, appliances on Work and Pleasure Boats.



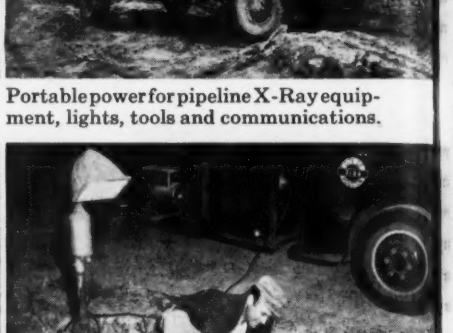
Portable power for pipeline X-Ray equipment, lights, tools and communications.

On-site power for construction tools, lighting in areas beyond mainline service.

Portable power for municipal maintenance equipment; tools, floodlighting.



Standby for critical processes in chemical, ceramic, and other manufacturing plants.



Line repair power and standby for electric, telephone, and gas utilities.

Provides power for lights, cooling, fudge heaters, fans for manufacturing ice cream vans.

Critical electric power for Civil Defense communications and lighting.

Onan Electric Plant that have never been used before

an Onan plant free

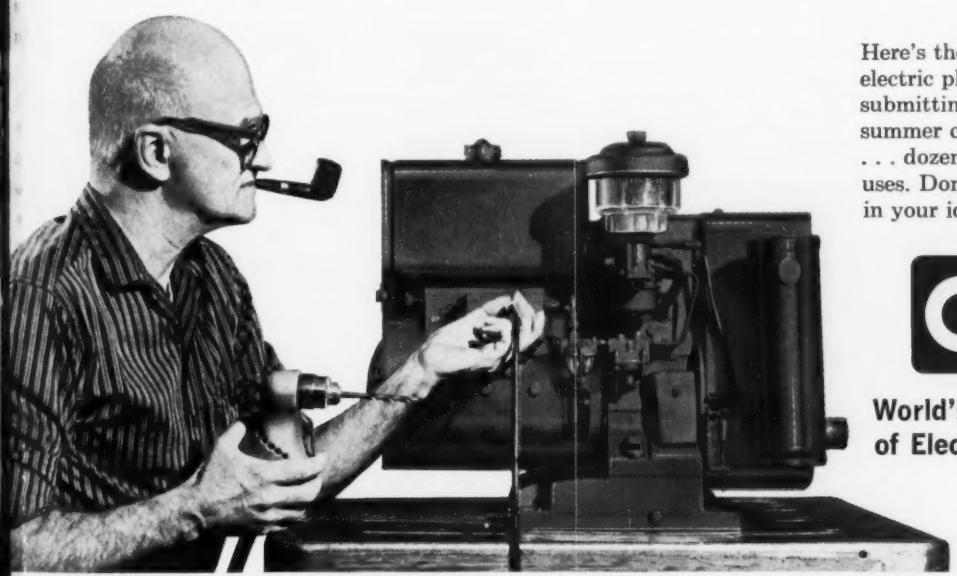
We'll give a 1,000-watt air-cooled Onan*(shown below) for each of the ten best applications for an Onan plant that have never been used before. Your idea can apply to any size or type Onan plant—from 500 watts to 230 kw—gasoline or diesel, air or water cooled.

In 1926, when Onan pioneered with the "Ten-Lite"—a 250-watt d.c. plant—there was a clear-cut need: enough power to burn ten electric lamps in hundreds of thousands of homes without electric utility service.

Today, this market is virtually non-existent in the United States. But hundreds of new uses undreamed of in 1926 have increased the need for electric generator sets each year. Thus, because men with ideas continue to find new uses for packaged electric power, Onan continues to build more plants than any other manufacturer.

Quite often, we never know who had the original idea for a new application. And, we're sure, Onan plants are used today in ways we've never heard about. If you have an idea for a new use, it may be helpful to you to see Onan plants at your local distributor. He's listed in the Yellow Pages in every major city. Or, write Onan for free literature.

*You may submit as many ideas as you wish, but no more than one Onan plant will be awarded to an individual. There are no restrictions on form of entry . . . you may submit photographs, sketches or a written statement of any length you desire. Onan will judge all entries on the basis of originality, practicality and commercial utility, and decisions of the judges will be final. If the same suggestion or similar suggestions are made by more than one entrant, the first one submitted, according to the postmark, will be eligible for the prize. Winners will be notified on or before July 15, 1961. Entries must be mailed to "New Uses Contest," address below, and must be received not later than June 15, 1961. All ideas submitted become the property of Onan and, whether or not the entries receive an award, may be used commercially by Onan in any way it sees fit with or without acknowledgment of the originator. No entries can be returned.



Here's the 1,000-watt Onan electric plant you may win for submitting your idea. Ideal for summer cottage, home standby . . . dozens of portable power uses. Don't put it off . . . send in your idea right away!

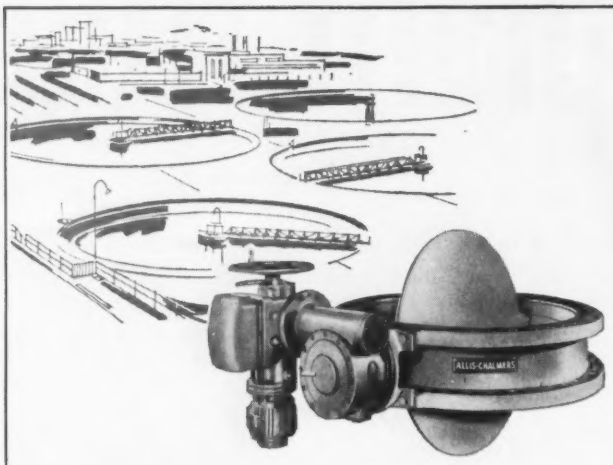
Onan®

World's Leading Builder of Electric Power Plants

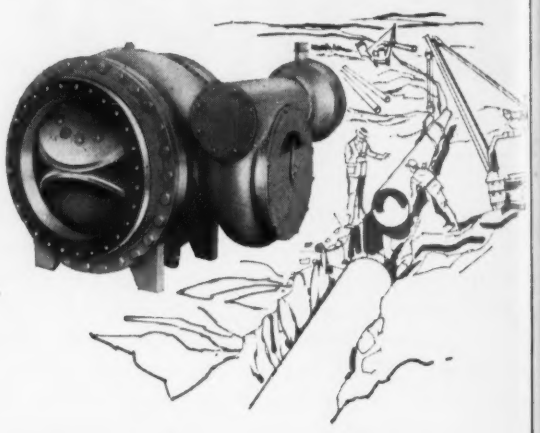
ONAN DIVISION, STUDEBAKER-PACKARD CORPORATION • 2677 UNIVERSITY AVENUE S. E., MINNEAPOLIS 14, MINNESOTA

For more facts circle 236 on Reader Service card, p 103

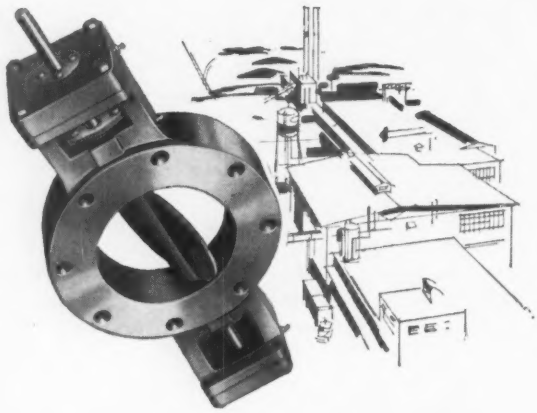
ALLIS-CHALMERS



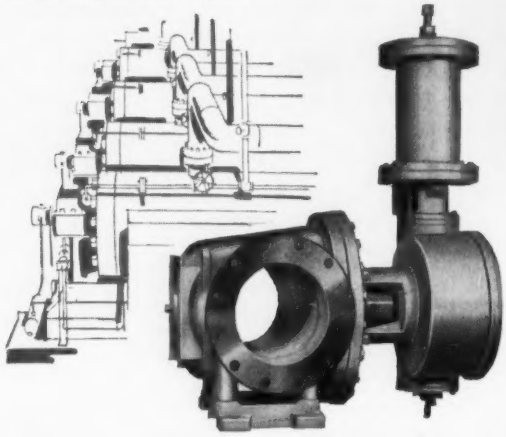
BUTTERFLY VALVES — For liquids or gases — uniform control in all positions, fast positive regulation and closure, minimum pressure drop. Compact and lightweight. Sizes from 1 in.



BALL VALVES — Easy manual shutoff under adverse conditions, and up to 150 psi. Slight wedging action gives unusually drop-tight closure. Sizes: 12 to 48 in.



WAFER VALVES — A new design of butterfly valves with space-saving flexibility, suited to most any type of operation. Sizes from 3 to 36 in., including high-pressure types.



ROTOVALVE — A cone valve suited to virtually any type of operation or location. Offers the least pressure loss, greatest initial shutoff, controlled closing time, positive seating.

Now: for power plants, sewage and water works —

a full line of rotary valves

Serving you even better through a broader line—Allis-Chalmers offers the finest in butterfly, ball and cone valves for industrial applications, power plants, sewage and water works. Also available are complete valving systems in standardized "packages" that provide *remote, telemetered control of valve operation.* These additions further round out Allis-Chalmers line that includes Angle, Needle, Relief valves, sleeve-type valves and accumulator systems. *For details, contact your Allis-Chalmers valve representative or write* **Allis-Chalmers,** *Milwaukee 1, Wisconsin.* Rotovalve is an Allis-Chalmers trademark.

A-1381

For more facts circle 237 on Reader Service card, p 103

PPG Fiber Glass Pipe Insulation is quickly installed, provides top thermal insulation at Fontainbleau Towers addition in Miami Beach. 100,000 ft of this insulation was used, as well as PPG Duct Liner and Duct Insulation.

"We chose PPG Fiber Glass Insulation Materials because they are easier to handle than any other insulation products"

. . . says Mr. Joseph Crabtree, President, Crabtree Insulation Company, Miami, Florida

Crabtree Insulation Company had the contract to install all pipe and ductwork insulation in the new 405-room addition to Fontainbleau Towers, Miami Beach. Choice of materials was given to the company.

Mr. Crabtree asked his superintendent what materials he felt should be used, and was advised that the men preferred PPG Fiber Glass Insulation Products because they were easier to handle.

As a result, Crabtree Insulation Company used 100,000 ft of PPG Pipe Insulation, 25,000 ft of PPG Neoprene-coated Duct Liner, and 25,000 ft of PPG Duct Insulation in the new Fontainbleau Towers addition.

Mr. Crabtree reports the insulation job went faster and with fewer problems than if other materials had been used. On the basis of this job and other jobs where he had used PPG materials, he would recommend PPG with no hesitation to other contractors.

WANT TOP RESULTS? TRY PPG!

PPG has a wide range of fiber glass thermal and acoustical insulation products that speed installation, provide excellent insulating properties, give long service life with little or no maintenance. If you haven't tried them, get full information by contacting your nearest PPG Fiber Glass Sales Office, or by writing *Pittsburgh Plate Glass Company, Fiber Glass Division, One Gateway Center, Pittsburgh 22, Pennsylvania.*

FIBER PPG GLASS

PITTSBURGH PLATE GLASS COMPANY

Sales Offices: Atlanta, Boston, Buffalo, Charlotte, Chicago, Cincinnati, Cleveland, Dallas, Denver, Detroit, Houston, Kansas City, Louisville, Los Angeles, Miami, Milwaukee, Minneapolis, New Orleans, New York, Philadelphia, Pittsburgh, San Francisco, St. Louis and Seattle.

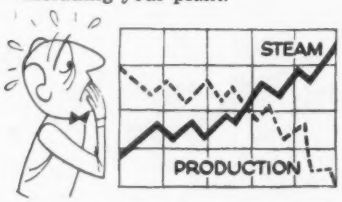
For more facts circle 238 on Reader Service card, p 103

ONE OF A SERIES OF CHATS ABOUT THE CONSERVATION AND CONTROL OF HEAT

SARCO TOPICS

STEAM CONSUMPTION WAS ERRATIC AT THE SHERATON-ATLANTIC

This is a documented steam story, and if you have the *least* interest in reduction of steam costs you'll read on. The events took place in the laundry and dry cleaning department of the Sheraton-Atlantic Hotel in New York, which purchases district steam; but they could have happened in *any* steam using establishment — including your plant.



This documentary is concerned with money — (their steam bills for laundry and dry-cleaning were tremendous) and how the Sheraton cut the bill $8500 in one year. That's giving away the climax, but not the plot. To begin with, the Sheraton engineering department kept a daily log which revealed excessive steam costs and startling discrepancies. For example, on one day, 44,000 lbs. of district steam were metered and 20,300 pieces finished. On another day, 38,000 lbs. of steam were metered and 23,300 pieces finished. Clue: This ratio was obviously cockeyed!

To relieve your suspense, we can tell you that the Sheraton removed competitive bucket traps and installed around fifty Sarco Thermo-Dynamic Steam Traps, Type TD-50, on the discharge side of each piece of steam heated equipment, and on drips on supply mains between meters and equipment, as recommended by Sarco. The results were dramatic. (Strong men didn't weep, but they did clap their hands a bit.) In the pre-Sarco December, 868,000 lbs. of steam were purchased for $1725. In the post-Sarco December, only 532,000 lbs. of steam were purchased, for $1025. And the volume of work had increased!

There are no crystal gazers on the Sarco staff; lots of competent engineers, though. These steam detectives find inefficient steam trapping at the bottom of countless high cost mysteries. Sad part of it is, the high cost of steam is only part of the story. Inefficiency in trapping can create other costly problems, too.

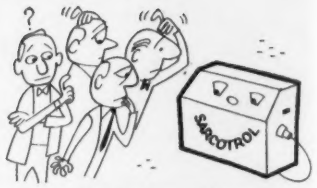
We talk a lot about our Thermo-Dynamic trap, don't we? So do other people. In fact we're quite used to grateful cheers of appreciation. Why don't you get the full story, by asking for it? Phone, telegraph, mail—choose your favorite medium of communication.

SARCOTROL! OUR WORD FOR SOMETHING SPECIAL IN TEMPERATURE CONTROL

It may be just what you've been looking for. We don't know. It's rather unusual. We know what it can *do*, but we still don't know everyone who needs it, even though we've been selling Sarcotrol successfully for many years to the plastic fabricating industry. New people we never heard of keep popping up saying it's just what they've needed.

When we designed Sarcotrol we planned it for specific use as a heating and cooling unit for injection molds, cylinders, rolls and drums. What surprises us is that so many different kinds of other equipment are evidently now in search of just such a control, from Banbury mixers to electric coffee pot testers.

The Sarcotrol is a portable, automatic temperature control system utilizing closed recirculation of the heat transfer fluid, to insure even temperatures throughout the equipment being heated and/or cooled. Here's the operating principle. Btu's are supplied to or removed from the rapidly moving high-pressure, high temperature fluid; the variations between delivery and return temperatures being held to a very narrow segment of the Sarcotrol's wide temperature adjustment range. A broad range of flow rates is available to handle widely varying heating and cooling loads, while maintaining tight control of temperatures across the equipment. The basic control mechanism is our own electric indicating controller. Four



standard, fully adjustable, working temperature ranges, cover all heating or cooling requirements between 0° and 300°F. (Keep reading . . . you can always go back for details.) On start-up, full heater capacity is available, and when circulating water approaches control point, heat input is automatically reduced for closer control. Temperature control instruments are automatically compensated for ambient temperature variations.

Heard enough? If not, you must feel a responsive chord vibrating, so write for details. There's literature available which contains much more information than we can give you in this chat.

OUR NEW PUBLICATION IS PRACTICAL—PLUS

SARCOSCOPE is our new house magazine into which we pour what we hope will be a useful mixture of ideas, case histories, tips, facts, news, and sense — both common and uncommon. If you are not receiving

it, we'll be happy to send future issues to you. Just send your name and address. Sarco publishes it as a service to people interested in the conservation and control of heat. We try to keep it down-to-earth, practical and useful.

SO YOU THINK YOUR PROBLEM'S UNIQUE?

Lots of hot water and steam is being wasted these days, in lots of ways. If your eyes glaze as you watch your steam bills mount or shut down your equipment for maintenance, you probably wonder what you did to deserve such problems. If it's any consolation, it's very unlikely that you are alone in your misery. The chances are excellent we have solved just such a problem already for plants similar to yours. Try us. Describe your problem in a letter. We'll probably be able to send you a set of Sarco Case Histories, describing how other plants were able to conquer problems like yours.

5897

SARCO

SARCO COMPANY, INC.
635 MADISON AVENUE, NEW YORK 22, N. Y.
PLANT: BETHLEHEM, PA.

STEAM TRAPS • TEMPERATURE CONTROLLERS
STRAINERS • HEATING SPECIALTIES

For more facts circle 239 on Reader Service card, p 103
circle 240 on Reader Service card, p 103 ➤

Multiclones remove soot at Los Angeles steam power plant

Oil burners in California... and coal burners in New Jersey...agree:

Electrostatic Precipitators catch fly ash at Sewaren steam power plant

When DUST is your problem— CLEAR IT WITH WP*

For an efficient, economical solution to any dust control problem—look to Western Precipitation. WP is uniquely fitted to handle your unique problem—being the one organization that custom designs, engineers and installs ALL types of dust and fume control equipment: Precipitator, Mechanical, Jet-Cleaned Filter, Hi-Temp Filter, scrubbers and engineered combinations.

With no axes to grind for any one system, WP engineers will give your job a completely unbiased recommendation—whether it's a quote on your specifications, a single component, or a completely engineered installation... small, major, simple, or complex.

An inquiry—on your business letterhead—will bring you literature promptly. Just write Western Precipitation, 1000 W. 9th St., Los Angeles 54, Calif. (In Canada, write 8285 Mountain Sights Ave., Montreal, P.Q.)

Dust and fume control since 1907

*WESTERN PRECIPITATION

Los Angeles 54 • New York 7 • Chicago 2 • Pittsburgh 22 • Atlanta 5 • San Francisco 4

Division of Joy Manufacturing Company

ELECTROSTATIC Precipitators
MULTICLONE Collectors
CMP Combination Units
DUALAIRE Jet-Cleaned Filters
THERM-O-FLEX Hi Temp Filters
TURBULAIRE Scrubbers
JOY-MICRODYNE Scrubbers
also: **HOLO-FLITE** Processors
HI-TURBIANT Heaters
TURBULEX Calciners

Unlike conventional electrical or pneumatic valves, new electro-hydraulically operated Hydramotors remain in last position when power is removed – until energized to trip. Designed by General Controls for use on the main gas and oil fuel lines of power plants, these Hydramotors are especially built and internally wired to close tightly in just one second – *but only on operator command.*

This eliminates the possibility of shutdown in case of power source failure...keeps flow to boilers constant at all times because these valves are electrically operated. No air pressure or pneumatic piping is required.

BE QUALITY SURE...ALWAYS SPECIFY GENERAL CONTROLS

GENERAL CONTROLS

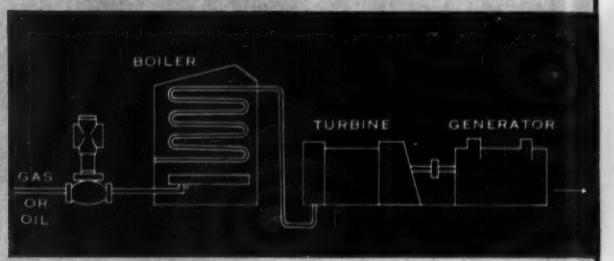
Automatic Controls for Product or Process

Glendale, Calif. • Skokie, Ill. • Guelph, Ontario, Canada

Nine Plants – 44 Factory Branch Offices Serving
The United States, Canada and Western Europe

For continuous fuel flow
and instant shutoff
–just say "when" to these new **HYDRAMOTOR®**

VALVES FOR POWER PLANTS



Hydramotor fuel shutoff valves are designed for pipe sizes from ¾" through 12" and are available with hermetically sealed power units in a choice of two types of actuators.

"KC" type, with simple 3-wire circuitry, uses AC power to open and close the valve. "KA" type, with 4-wire circuitry, meets the requirement of standby power by using AC power to open the valve and DC voltage to close it in case of emergency.

If your requirements are for standard Hydramotors which de-energize to trip either full closed or full open on interruption of power, these are also available.

Standard, drip proof, explosion proof and weather proof enclosures are available. Accessories include dust shields, limit switches, potentiometers and manual opening device.

SPECIAL SWITCH UNIT AVAILABLE

An auxiliary switch unit, with three switches that are independent of Hydramotor controls, is available to interlock the shutoff valve with other power plant systems. Each switch is adjustable to trip at any position of valve stroke. This explosion proof, weather proof unit can be mounted in the field. Six SPDT switches may be obtained by using two of the units with a Hydramotor.

Write today for specifications and complete information. Ask for Bulletin SD1-H2, 3KA, C-1 (Hydramotor Shutoff Valves) and Bulletin 606.287 (Auxiliary Switch Unit).

Now it's much easier to solve your pipe motion problems

. . . with new Flexonics EXPANSION JOINT *ENGINEERING GUIDE*

New convenient way to solve pipe motion problems! Flexonics Expansion Joint Engineering Guide—just off the press—contains a wealth of vital information in easy-to-read, easy-to-use form. 42 pages of calculations, tables, anchoring and guiding data. Every piping system designer needs this new book. Mail the coupon for your FREE copy!

EJ-275

Flexonics

DIVISION OF CALUMET & HECLA, INC.
382 East Devon Avenue • Bartlett, Illinois

FLEXIBLE METAL and SYNTHETIC HOSE
EXPANSION JOINTS
BELLOWS • SPECIAL TUBULAR ASSEMBLIES

In CANADA
FLEXONICS CORPORATION OF CANADA, LTD.
BRAMPTON, ONTARIO

ATTACH TO YOUR LETTERHEAD—MAIL TODAY!

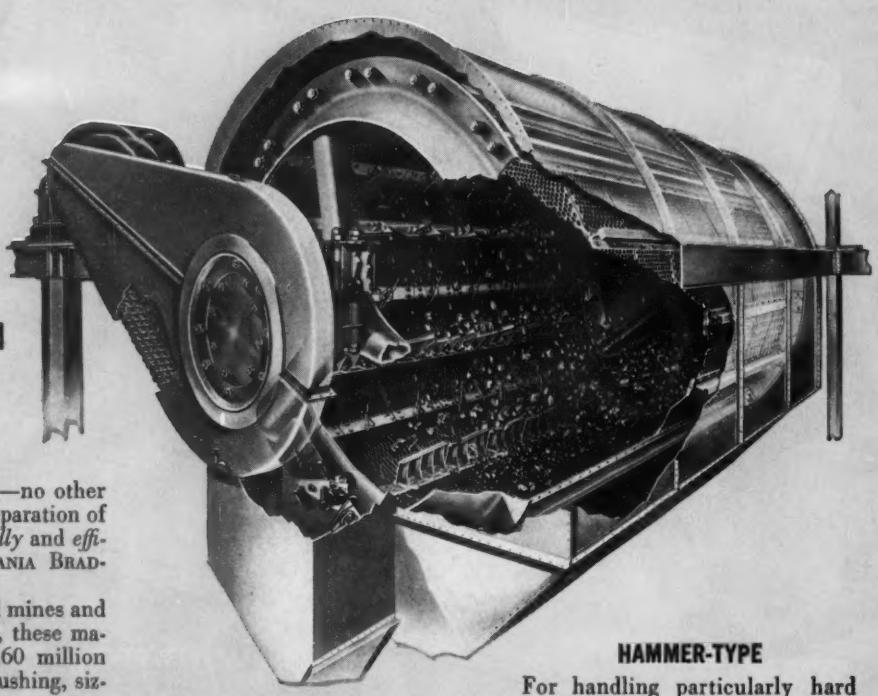
Flexonics
382 E. Devon Avenue
Bartlett, Illinois

Please send my free copy of the new Flexonics Engineering Guide on Expansion Joints, Expansion Compensators, and Pipe Guides and Supports.

◀ circle 241 on Reader Service card, p 103

For more facts circle 242 on Reader Service card, p 103

For maximum economy in preparation of ROM coal—it's PENNSYLVANIA BRADFORD BREAKERS



Trunnion-mounted Roller-mounted Hammer-type

Mine-side or plant-side—no other crusher handles the preparation of ROM coal as *economically* and *efficiently* as a PENNSYLVANIA BRADFORD BREAKER.

At power plants, coal mines and by-product coke plants, these machines prepare over 160 million tons of coal a year—crushing, sizing and scavaging all in one continuous operation, at capacities up to 1500 TPH, and at average maintenance costs as low as $.001 per ton and power consumption averaging .204 KW per ton.

ROM coal is continuously charged at loading end. Passing sizes are immediately screened out. Larger lumps are raised by radial lifting shelves and dropped, breaking along natural cleavage planes to desired screen size, with minimum fines.

Refuse such as bony, sulphur balls, slate and rock, resist breakage, are automatically discharged at the refuse end along with tramp iron, timbers, etc.

ROLLER-MOUNTED

Roller-mounted BRADFORD BREAKERS are particularly adapted for use at coal mines, as the spider at the loading end is designed to permit loading of extra large lumps of coal.

TRUNNION-MOUNTED

Trunnion-mounting, where the revolving cylinder is suspended on trunnions, is the popular type for plant-side installations.

HAMMER-TYPE

For handling particularly hard coals, or for heavier loading, the BRADFORD BREAKER is combined with a concentrically-mounted rotor of a hard-hitting PENNSYLVANIA HAMMERMILL at the rear end of the breaker.

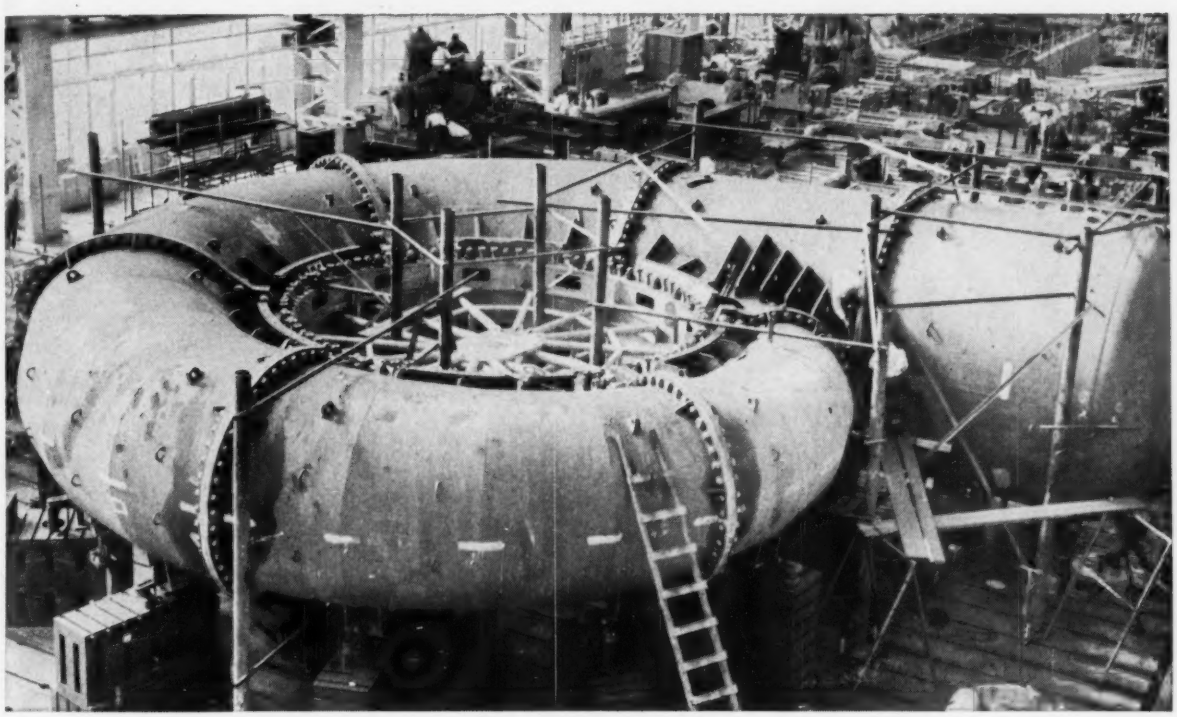
Whatever the type most suitable for your need, if it's *economy* and *efficiency* you want—investigate PENNSYLVANIA BRADFORD BREAKERS. Write for catalogs, or call a Pennsylvania Engineer.

PENNSYLVANIA CRUSHER DIVISION
BATH IRON WORKS CORPORATION
WEST CHESTER, PENNA.

PENNSYLVANIA CRUSHERS
BATH-BUILT

HITACHI

now completing the first hydraulic turbines for Thailand's Yanhee Project



Shop tests were recently completed on the spiral casing for the first of two 115,000 HP Francis-type turbines being completed by Hitachi for Thailand's Royal Irrigation Department. These will be the first of the planned 8 sets of generating units to be installed at the downstream of the Bhumiphol Dam, as part of the Yanhee Multipurpose Project which will commence operation in 1963 and eventually supply 560,000 kW of power to Bangkok and Thonburi. The vertical shaft Francis turbines have been designed to deliver 115,000 HP under the effective head of 112m and for a speed of 150 rpm. Their spiral casings, with inlet diameter of 4150mm, will each be divided into 7 sections for transportation by barge up the Ping River to the site.

Hitachi, Ltd.
Tokyo, Japan

Cable Address: "HITACHY" TOKYO

For more facts circle 244 on Reader Service card, p 103

POWELL MAKES IT A SIMPLE MATTER

To find the right valve for power plant installation, just call Powell. It's that simple, since Powell can supply just about any type of valve you may need to control water, oil, gas, air, steam or corrosive fluids.

What's more, you don't have to wonder about Powell performance. It's built-in through sound engineering, development, materials and workmanship . . . and proved day in, day out.

So, remember, finding the right valve can be a simple matter when you specify Powell. For further information, call your nearby Powell Valve Distributor (there's one in every major city), or write us direct.

115th year of manufacturing industrial valves for the free world

POWELL HIGH PRESSURE **VALVES**

THE WM. POWELL COMPANY CINCINNATI 22, OHIO

For more facts circle 245 on Reader Service card, p 103

LOUIS N ROWLEY, EDITOR • MAY 1961 • ESTABLISHED 1882 **Power**

Cart before the horse?

That's a question we're beginning to hear in connection with standards for industrial equipment. It's not a matter of the value of standards, or of their benefits to manufacturers and users—these are undeniable. But concern *is* expressed over the way we go about setting up the standards.

Cause of this concern might be summed up like this: Although the users outnumber the manufacturers by several orders of magnitude, and in the last analysis should be the primary beneficiaries, there is a tendency for standards to become manufacturer-oriented. Instead of starting with the user and his application problems and then working back to matters of manufacture and test, too often procedure starts with manufacture and test portions of a standard and then an attempt is made to set up an application section to fit them.

This comes about quite naturally. Manufacturer engineers are highly skilled in their specialized areas and, in general, have a more direct and immediate interest in the setting-up of standards. And, being a smaller and more cohesive group, they can be enlisted in standardization activities far more readily. This, as any one concerned with voluntary projects of any kind can tell you, is mighty helpful.

In contrast, user engineers are scattered in many industries with widely different problems. They tend to be specialists in the application of several kinds of equipment, rather than in the design and development of one. And, by and large, they do not take an active interest in standardization work, tend to neglect the available opportunities to participate.

Looking objectively at this situation, I cannot agree that the order in which a standard is developed is basic to the problem; in fact, I can visualize situations where manufacture and test standards *should* come first, with application guides being relatively unimportant. What *is* basic is that user interests be considered at every step and that these interests be amply represented in standardization committees and task forces.

If user interests are to be insured, two obligations must be met. The first falls on those charged with organizing and directing standardization committees: the obligation to make sure that user participation is not only ample in number but is truly representative. *All* important industrial user groups should be involved. This is not easy to accomplish, but better and more useful standards will result if real time and effort is invested in securing full and balanced industrial-user representation.

Perhaps most important of all is the obligation we carry as individual energy-systems engineers: the obligation to develop an intelligent interest in standardization work and to participate in it actively. Development of sound standards for the equipment used in the energy systems of industry is a matter of vital concern to us and to our companies. If we do not play a far stronger role in developing these standards than we have in the past, we will have no one to blame but ourselves if we do not reap the values and benefits they should yield.

"WHAT'S THE BEST VALVE MADE?"

"JENKINS o'course"

"I favor JENKINS"

"We s

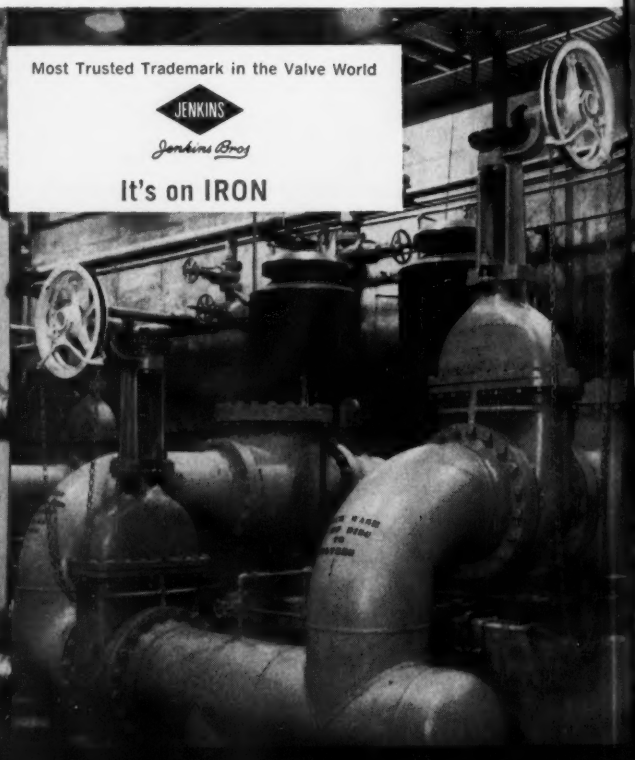
Whatever The Type...It's A Good Feeling

Most Trusted Trademark in the Valve World

JENKINS

Jenkins Bros

It's on BRONZE



Most Trusted Trademark in the Valve World

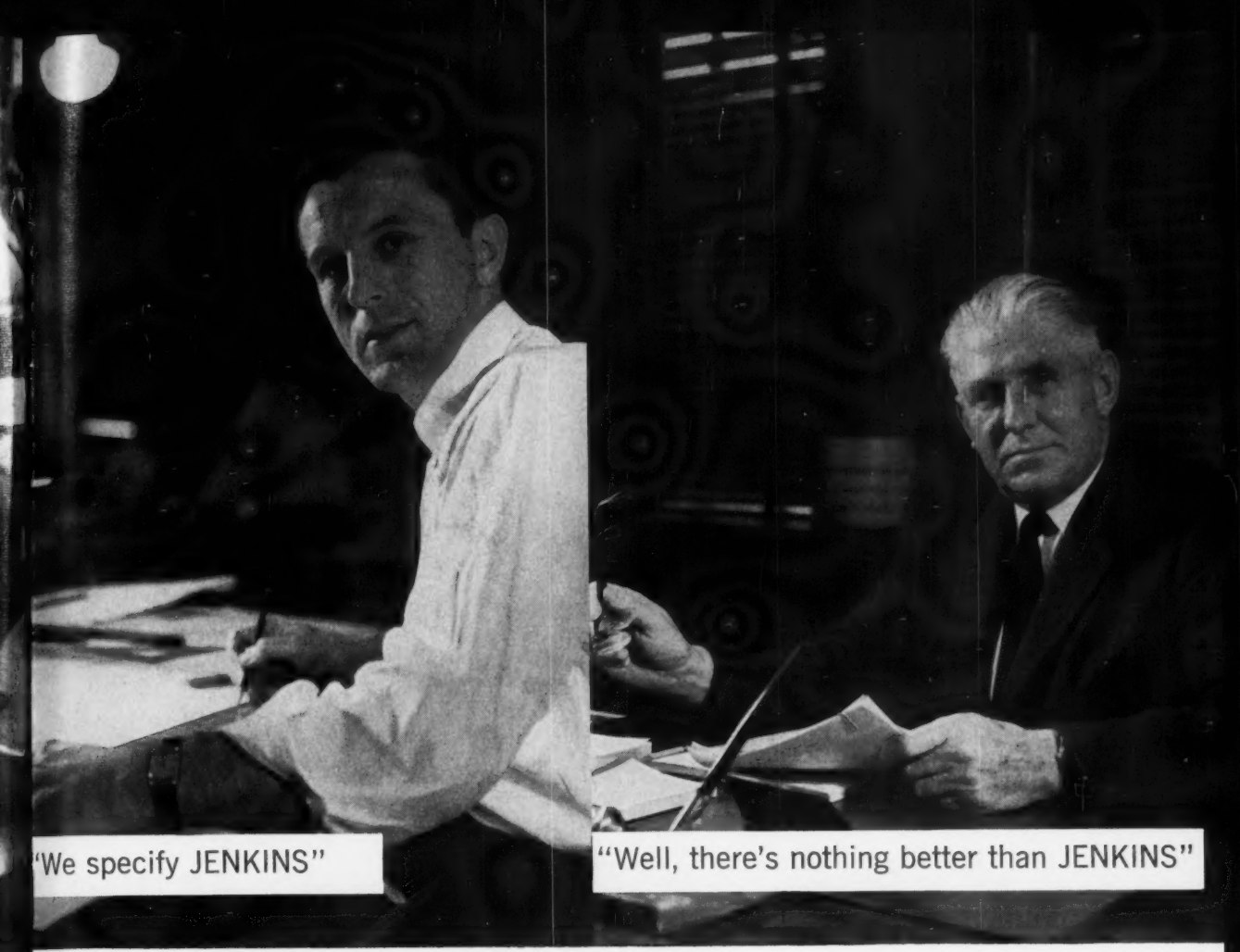
JENKINS

Jenkins Bros

It's on IRON

t Truste

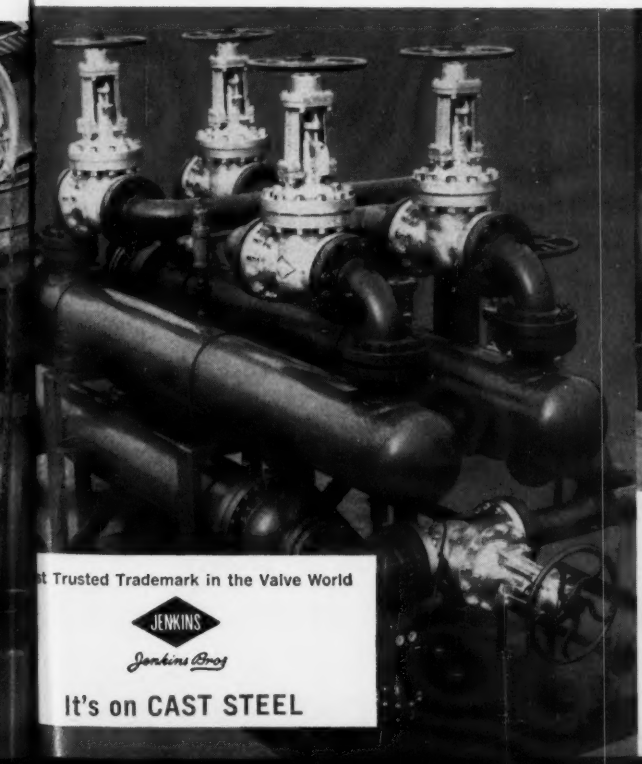
It's



"We specify JENKINS"

"Well, there's nothing better than JENKINS"

To Have The Valve Everyone Trusts



t Trusted Trademark in the Valve World

JENKINS

Jenkins Bros

It's on CAST STEEL

Most Trusted Trademark in the Valve World

JENKINS

Jenkins Bros

It's on STAINLESS STEEL

JENKINS

MOST TRUSTED TRADEMARK IN THE VALVE WORLD

VALVES

JENKINS SINCE 1864

Jenkins Bros

Sold Through Leading Distributors Everywhere

He's gunning B&W KAOCRETE-D ...the refractory castable that withstands punishing ashpit service

Relining ashpits in stoker-fired or pulverized-coal-fired boilers is expensive and time-consuming. To reduce maintenance in this severe service, B&W has developed durable Kaocrete-D, a refractory castable which can be wet or dry-gunned into place — or cast using modern materials handling methods. It withstands the punishing effects of abrasion, erosion and spalling in virtually every ashpit design.

Widely used in all types of boiler ashpit hoppers and slag tanks, Kaocrete-D has proved its economy and durability. Where abrasive and erosive conditions are less severe, B&W Kaocrete-A will give satisfactory service.

Cut the frequency of maintenance and expensive relining jobs by using heavy-duty B&W Refractory Castables. Send for Bulletin R-40 which gives data on B&W Kaocrete Refractory Castables for lining ashpits. Write to: The Babcock & Wilcox Co., Refractories Division, 161 East 42nd Street, New York 17, N. Y.

B&W

THE BABCOCK & WILCOX COMPANY

REFRACTORIES DIVISION

R&70

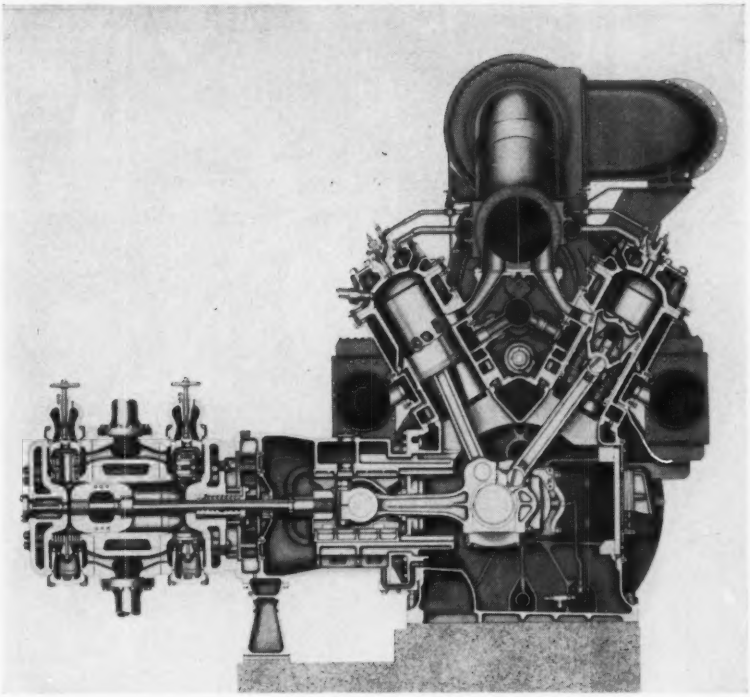
B&W Firebrick, Insulating Firebrick, and Refractory Castables, Plastics, Ramming Mixes, Mortars, and Ceramic Fiber.

◀ Circle 246 on Reader Service card, for preceding ad

For more facts circle 247 on Reader Service card, p 103

Design and equipment application section

B G A SKROTZKI
Associate Editor in Charge



Two-cycle natural-gas-burning engine attains . . .

Better cylinder scavenging through patient research

By M J HELMICH
Assistant Chief Engineer
Development Division
The Cooper-Bessemer Corp

For many years engine builders have striven to achieve complete and effective scavenging within engine cylinders. This effort has followed two methods for 2-cycle engines—(1) uniflow (2) loop scavenging.

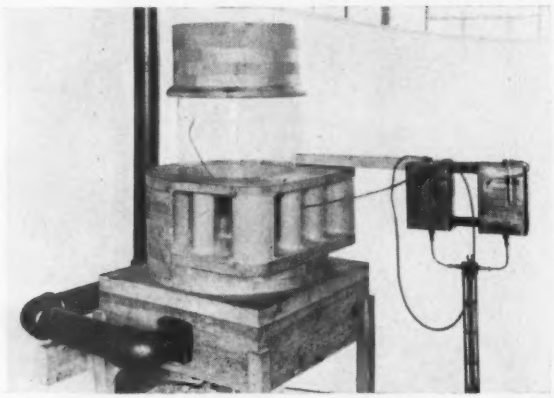
Since 1937 we have built a line of 2-cycle natural-gas-burning loop-scavenged direct-angle reciprocating-compressor engines. These have an inherent simplicity compared to uniflow-scavenged cylinders with a mechanically operated exhaust valve in the head. Loop-scavenged engines, however, lack valve-timing flexibility because of fixed location of inlet and exhaust ports.

Many methods, both theoretical and actual, have been developed to measure scavenging efficiency. Among these is a simple relationship of charging efficiency determined by a fuel-air measurement and an exhaust analysis. We rely on a static flow-test method for determining optimum combustion-chamber design in our loop-scavenged 2-cycle engines.

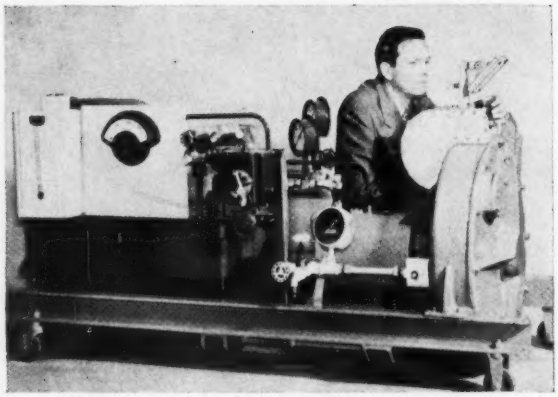
Fig. 1 shows a typical static flow test in the laboratory. A standard cylinder casting is sectioned directly above the exhaust ports; a transparent plastic portion mounts on the casting to represent the cylinder head and port region. A small centrifugal blower feeds air into the cylinder. A wooden piston crown mounted in the bottom simulates the piston.

A probe rod projects into the cylinder through the inlet and exhaust ports. It carries a ball of cotton saturated with titanium chloride to produce vapor trails. The trails are observed at various positions in the cylinder and recorded in sketches. Fig. 3 shows a plane through the center line of the cylinder and perpendicular to the crankshaft. Inlet and exhaust ports, built of wood, are modified during the testing program to see effect on the flow patterns.

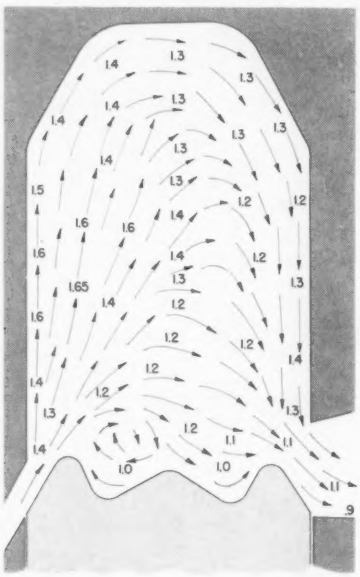
continued



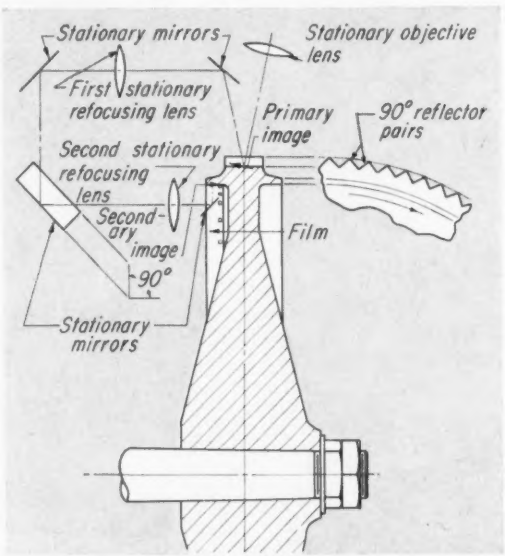
1 Static flow test puts cylinder casting above exhaust ports. Transparent plastic portion represents cylinder head and ports



2 Isotransport camera can expose 6-ft strip of 8-mm film at the rate of 100,000 frames per second. It's actually used at 20,000



3 Static tests give data for loop-scavenging flow in the engine cylinder



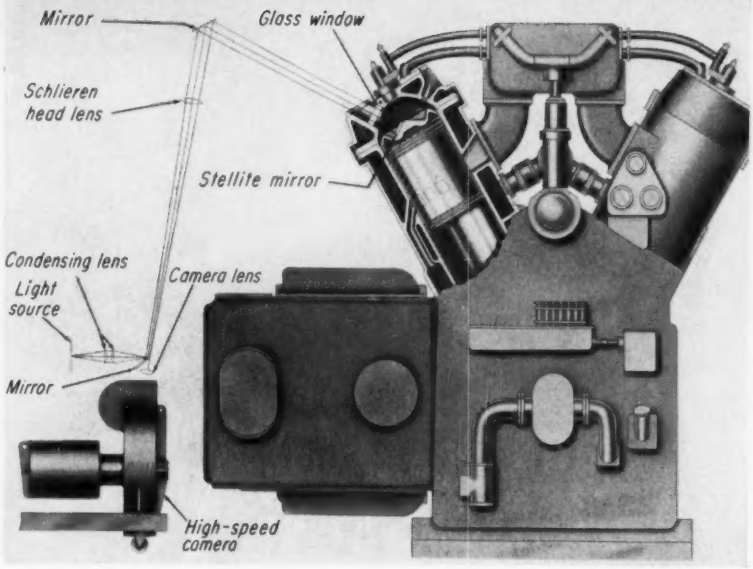
4 Optical system of the Isotransport camera (not drawn to scale) uses a 2-ft-dia disk carrying 500 reflector pairs on its rim

Both direction of flow and relative air velocities are shown. In this particular test the inlet ports extended 210-deg around the cylinder and focal point of all inlet ports was near the head on the inlet side of the cylinder. A slight turbulence takes place above the center of the piston crown.

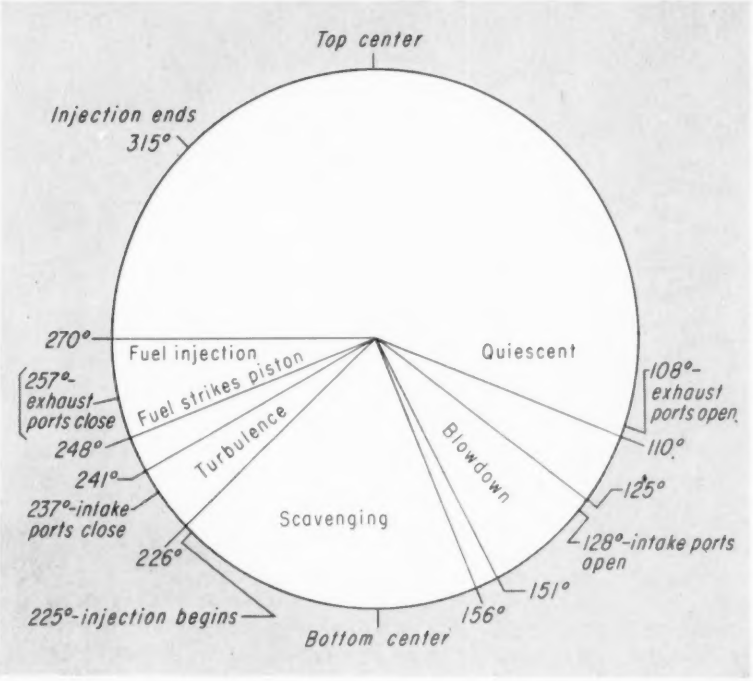
Besides air flow in the cylinder, injection of gas and location of the spark plug are important to effective performance and low fuel consumption. We have made similar static studies of gas injection patterns, penetration and dispersion. From these we decided to inject gas considerably below top dead center, TDC, in the engine stroke when cylinder pressure is low and when both inlet and exhaust ports are closed; this insures optimum fuel economy. A side spark-plug location giving a relatively slow and long flame front as well as moderate firing pressure was also developed from these tests.

Photography. During the war years much work was done at Battelle Memorial Institute under the direction of C D Miller in photographing cycle events within a small diesel and spark-ignited gasoline engines. In 1949 a joint photographic-research program was organized to study combustion in our GMV, a 14x14-in. 300-rpm loop-scavenged direct-gas-injection V-angle compressor engine. Photo on previous page shows the latest model of this engine, GMVC.

Program involved several innovations: (1) An engine the size of this one had never been photographed before. (2) This was the first natural-gas-burning engine to be photographed. (3) Flame front and combustion had been photographed but never the movement of air and exhaust gases during the intake and exhaust portions of the cycle.



5 Low luminosity of gas flame made it necessary to use Schlieren method of photography to study action of gases in cylinder during combustion and expansion processes



6 Comparison of valve timing with actual cylinder events photographed shows where improvement can be made to synchronize gas flow with outlet- and inlet-port openings

During the 15-month initial phase of the project, Battelle designed a special high-speed motion-picture camera called the Isotransport, Fig. 2. Fig. 4 shows schematic arrangement of the optical system. It uses 500 reflector pairs of steel plates mounted on a 2-ft-dia disk. The rotating disk carries a 6-ft strip of standard 8-mm movie film.

A geared piston type hydraulic motor drives the camera disk. A 1000-psi rotary pump driven by a 10-hp 3-ph induction motor supplies the fluid. The drum could run at 12,000 rpm to expose 100,000 frames of film per second, but our work needed a standard of only 20,000 frames per second for sufficient accuracy.

Camera was used continuously from March 1950 to March 1952 in our Mount Vernon, Ohio plant. A total of 648 shots were made using five different photographic setups. Each shot exposed six ft of film with the engine running at 300 rpm to capture 45-deg of engine crank travel.

Five processes of the engine cycle were photographed: (1) ignition (2) flame propagation (3) exhaust blowdown (4) cylinder scavenging (5) turbulence. One cylinder of a standard GMV engine was modified to let us photograph these events. Five different setups were used.

Fig. 7*a* shows the setup for taking pictures through the cylinder head with the piston at or near top center. A mirror was mounted in the top of the piston and a 5-in. quartz-glass window, 1-in. thick, was placed in the cylinder head, to be used for photographing turbulence and flame travel in its later stages.

Fig. 7*b* shows the setup for pictures taken during early combustion. A special spark plug with long electrodes was used to place the spark well within the field of view.

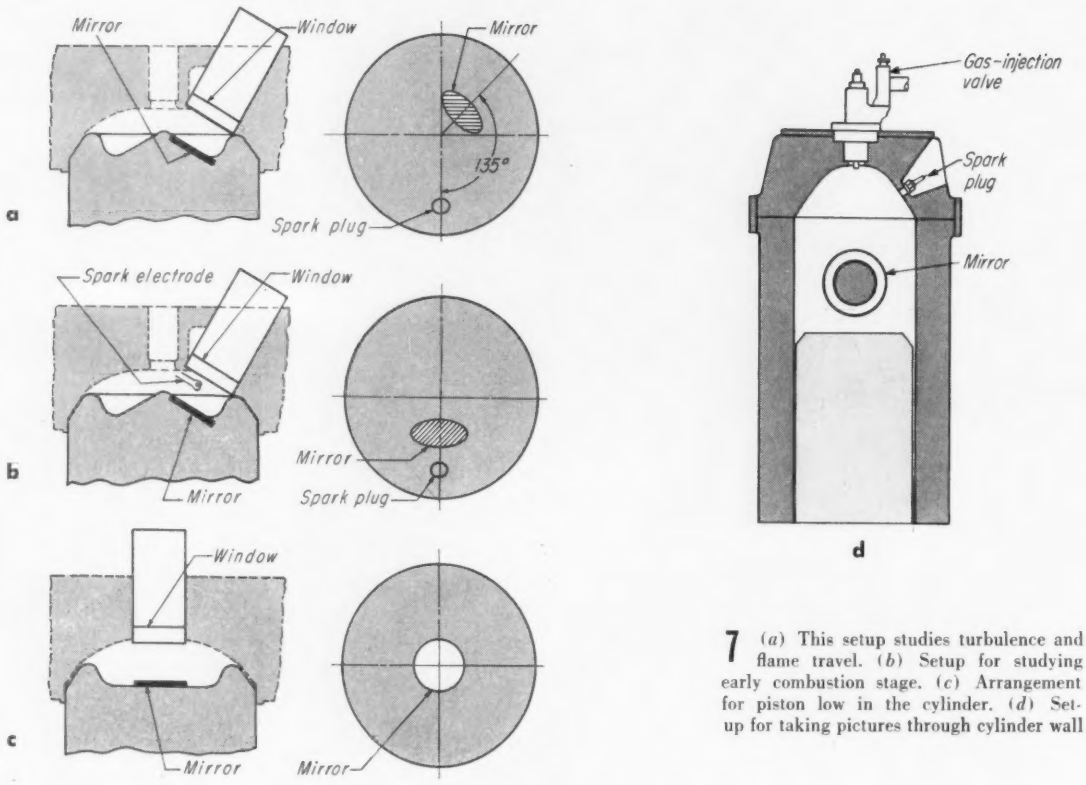
Fig. 7*c* shows the layout for photographing through the cylinder head with the piston low in the cylinder.

Fig. 7*d* shows the setup for photographs taken through the lower cylinder wall, perpendicular to the crankshaft as well as to the average direction of flow of exhaust gas and scavenging air.

Many problems arose. Natural luminosity of the flame in the cylinder was insufficient to permit direct photography. To overcome this we tried the Schlieren method of photography, projecting an external light source through the gaseous medium. This pictures normally invisible gas flows by letting the camera record differences in the optical density of the gases. Fig. 5 shows the schematic arrangement for photographing through the cylinder head.

Various intensities had to be used for the external light source to produce uniform film exposure throughout the cycle. Sources varied from a 500-w incandescent projection lamp to a carbon-arc lamp, finally a brilliant Ames high-pressure mercury-arc lamp of 20,000 lumens.

A special oil-control piston had to be designed to prevent passing lubricating oil into the combustion chamber. Test cylinder was fired only during the time film was exposed—with no appreciable firing pressure,



7 (*a*) This setup studies turbulence and flame travel. (*b*) Setup for studying early combustion stage. (*c*) Arrangement for piston low in the cylinder. (*d*) Set-up for taking pictures through cylinder wall

oil control was a major problem. Oil in the combustion chamber immediately formed a mist covering mirror and window to prevent photography. So in addition to a special oil-control piston we installed a large vacuum pump to help drain oil from the cylinder, Fig. 9.

Other problems included developing a relay system to control the camera shutter. A special spark plug complete with a miniature optical projector was built to record timing marks on the film.

Exposures were made by: (1) starting camera and bringing up to speed (2) turning on light source (3) starting engine (4) firing test cylinder several times (5) taking photographs (6) stopping engine (7) stopping camera.

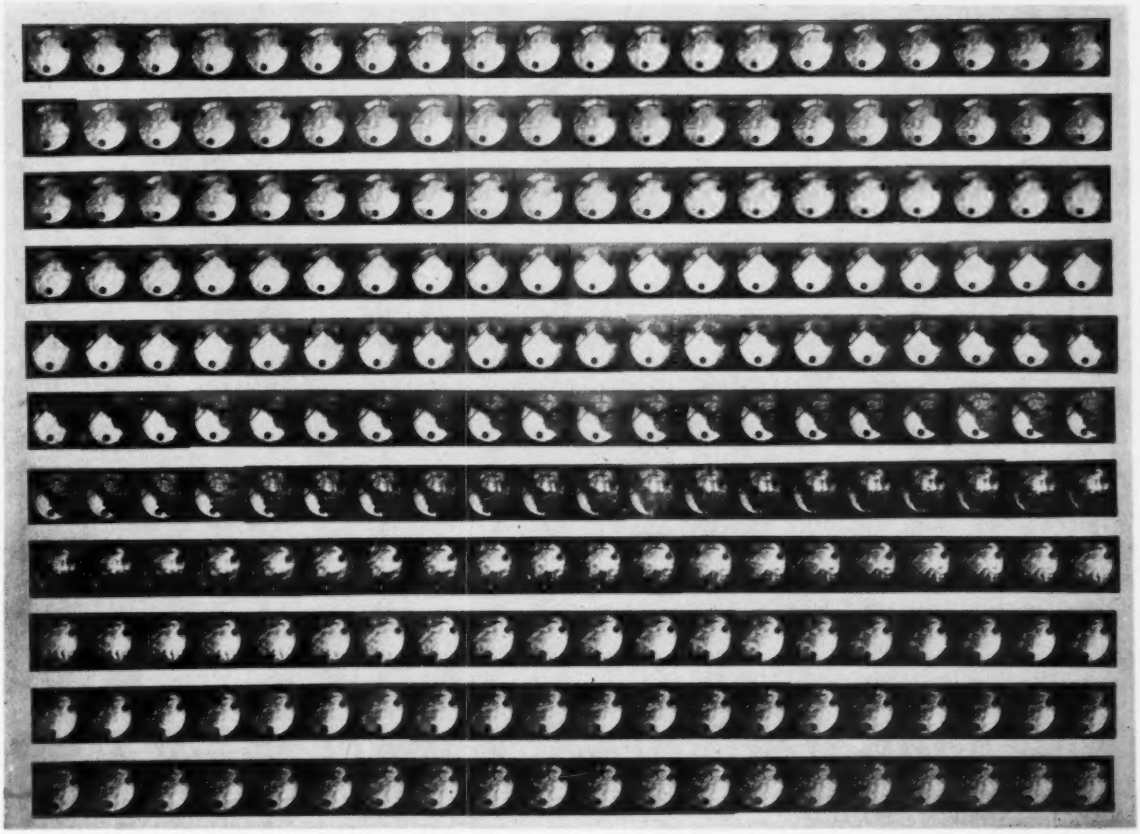
Results. At the end of test program in 1952 the 648 strips of film were edited and studied to provide directions and speeds of flame and gas movements during the complete cycle. The 8-mm film strips were spliced together and rephotographed on 16-mm film to get a complete sequence throughout the engine cycle.

Fig. 8 reproduces 220 individual frames exposed at 20,000 frames per second through the cylinder head in the vicinity of the igniting spark. Each frame represents an interval of 50 microseconds. These show the flame front and its position.

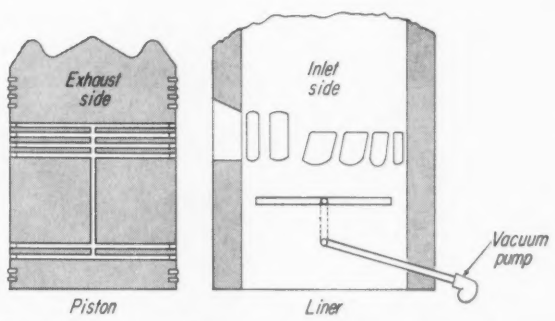
Fig. 6 compares the mechanical timing of the GMV cylinder with the actual average crank-angle ranges covered by exhaust blowdown, scavenging, turbulence and fuel injection as determined by pictures taken through the lower cylinder wall. Certain discrepancies show up between the crank angles for the beginning and end of various events as seen by the camera and the known mechanical timing for opening and closing the inlet and exhaust ports. For example, first evidence of exhaust blowdown within the cylinder starts 20-deg after the exhaust ports are known to be open. Blowdown continues 23-deg after the inlet ports open and the first flow of scavenging air into the cylinder starts 28-deg after the inlet port opens. All evidence of scavenging-air flow into the cylinder ends 13-deg before inlet ports finally close.

We expected discrepancies to crop up, traced to the inertia of gas. But these specific results gave our design department new insight for both timing and port shapes.

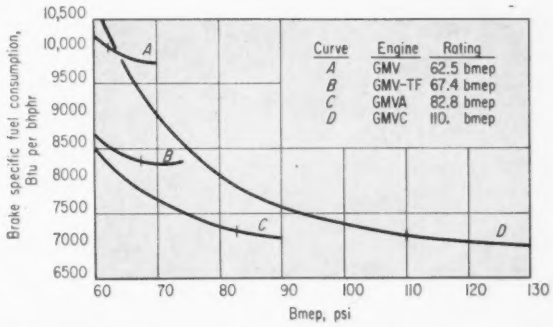
Analysis revealed these facts about flow of scavenging air and exhaust gas in the GMV cylinder: (1) Exhaust blowdown followed a pattern of laminar flow. (2) Scavenging air entered the cylinder in the the form of turbulent jets or "fingers" penetrating and mixing with combustion residuals still in the cylinders. (3) Gas injection has the needed penetration and timing is correct to prevent loss of any fuel through the exhaust ports. (4) Turbulence in the cylinder is right for good combustion, indicating complete and uniform mixing of fuel and air charges. (5) Design intention—complete scavenging loop—is achieved, though it's modified to a certain extent by entrance of air into



8 Flame front shows smooth travel through cylinder head in vicinity of the igniting spark. Schlieren photographs show varying density of gases as they burn. Intervals between pictures represent a time interval of 50 microseconds (20,000 frames per sec)



9 Oil-control piston had to be designed to prevent oil entering cylinder during firing and misting up the burning gas



10 Improved scavenging has contributed to both lower heat rate and greater load-carrying ability of natural-gas engines

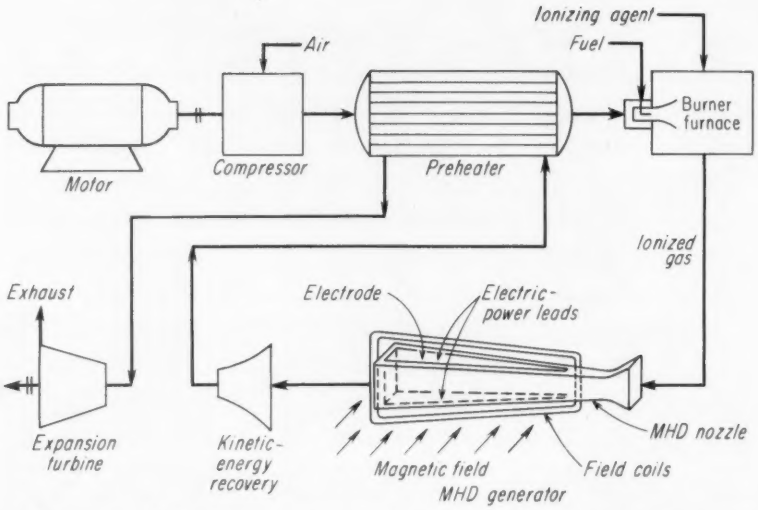
cylinder in the form of turbulent jets.

An important benefit of this study: indication that the static method of analyzing flow through a cylinder was a satisfactory approach to the design of a loop-scavenged combustion chamber. Method costs less and has been used in studies aiming to modify other 2-cycle engines.

Concurrent with the photographic study a series of tests was made with a uniflow-scavenged GMV cylinder—no improvement of performance. As a result we have continued to develop and improve our line of loop-scavenged engines.

Fig. 10 shows improvement in fuel consumption of the GMV line of engine, from the GMV on which the combustion photographic work was done to the latest turbocharged engine. Load-pulling ability has increased 186%; specific fuel consumption drops from 9800 to 7000 Btu per bhphr. Radically new loop-scavenged cylinders have been designed and are currently being evaluated in the research laboratory—we hope to realize still greater improvements in scavenging efficiency and performance.

By C G VON FREDERSDORFF
Senior Chemical Engineer
Institute of Gas Technology



1 Independent MHD electric generator would use motor-driven air compressor to pressurize combustion air at start of cycle and expander at end to salvage waste heat

Theory has been pretty well proved for drawing electric energy from high-temperature gases speeding through strong magnetic fields. Here are results of a study of . . .

Magnetohydrodynamic generation

The magnetohydrodynamic process (MHD) generates power by forcing a high-speed pressurized ionized gas through a magnetic field, Fig. 1 and 2. Ionization requires temperatures from 3000 to over 4500 F. (See POWER, Nov 1959, pp 62-65 for a general discussion of MHD.)

In a conventional electric generator a turbine drives copper wires through a magnetic field, but in a MHD generator the electron flow is induced in the working fluid itself. Experimental MHD generators use an elongated nozzle with two spaced collector plates along its length to withdraw energy. The collector plates or electrodes correspond to brushes in a conventional generator. External coils induce a strong magnetic field across the flowing ionized gas.

Independent MHD, Fig. 1, would have: (1) motor-driven air compressor (2) regenerator or preheater for recovering heat leaving MHD nozzle (3) pressure burner yielding ionized combustion gases (4) convergent-divergent nozzle to develop gas velocity at or near sonic.

This cycle replaces a conventional steam generator with all its components—feedwater pumps and heaters, turbine and generator and the main condenser. The MHD cycle can be improved by adding a short diffuser to recover kinetic energy of the gases leaving the MHD nozzle; this raises the pressure and temperature of the gases for improved heat transfer in the preheater. An expansion turbine can be added after the preheater to convert pressure energy of the exhaust gases to shaft work.

MHD topping process, Fig. 2, would exhaust the gases from the preheater into a conventional steam generator supplying a steam turbine driving an electric generator. This cycle has the advantage of: (1) decreasing the temperature approach needed in the preheater (2) raising the overall plant efficiency above conventional levels (3) reducing the plant size for a given capacity.

Power density. Fig. 3 shows an ideal MHD circuit with electrodes of area A spaced D units apart in series with a load resistance r_L having a voltage drop e_L. Total dc voltage V generated in the fluid, assumed in 1-dimensional flow in direction x, is:

$$V = IR_e(1 + m) \qquad (1)$$

where $m = r_L/R_e$; I = total dc flow and R_e = total effective resistance between electrodes. In terms of effective average gas conductivity σ in direction of current, flow is $R_e = D/A\sigma$.

The fluid flows through the nozzle with velocity v_g across a magnetic field with flux density B to develop total power per unit nozzle volume:

$$P = \sigma v_g^2 B^2/(1 + m) \qquad (2)$$

Taking the line drop into account, power density to load is:

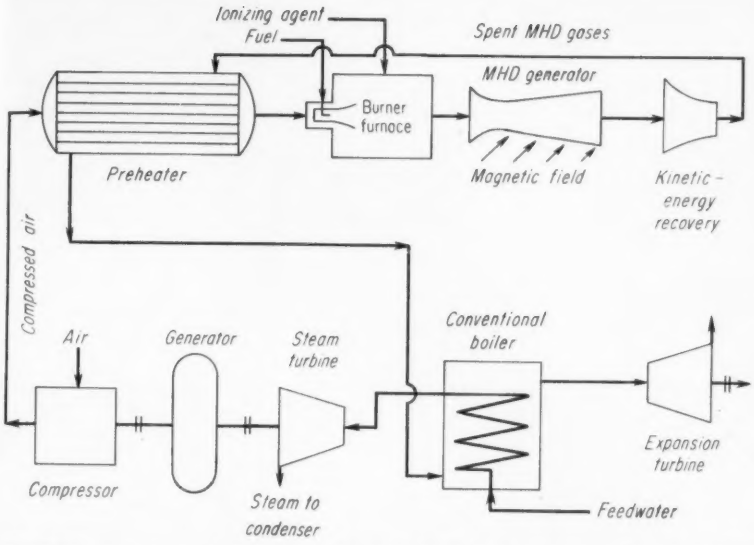
$$P_L = \sigma v_g B^2 m/(1 + m)^2 \qquad (3)$$

These assume that magnetic-flux direction is perpendicular to direction of gas velocity v_g. Effective electric-current flow is perpendicular to gas flow and magnetic flux. If P_L is in watts per cu meter, σ = mhos per meter, B = webers per sq meter (1 weber per sq meter = 10,000 gauss) and v_g = meters per sec.

With m as the resistance ratio, the ratio:

$$(P - P_L)/P = 1/(1 + m) \qquad (4)$$

represents losses from fluid ohmic resistance that decreases availability of thermal energy for conversion to electrical energy. Fluid turbulence at high Reynolds numbers causes local



2 MHD-topped conventional plant would take exhaust from preheater as furnace gas for conventional steam generator. Steam turbine would also drive the air compressor

# of electric energy

fluctuations in induced electric field and current density. It may be accounted for by decreasing the ratio m; other losses may be allowed for the same way.

Ratio m should be about 10 to approach reversible withdrawal of power to load. Complete reversibility with an infinitely conducting gas makes R_e approach zero and m approach infinity. A short circuit, complete irreversibility, makes $m = 0$. But $m = 1$ is the condition for maximum power density to load or minimum nozzle volume in an idealized system. As m rises above unity the nozzle volume per unit-load power density tends to shoot up rapidly.

Force and energy balance. With frictionless flow of the ionized gas through the MHD nozzle, retarding action of the magnetic field will cause a pressure drop. The property relations for steady flow then will be:

$$\frac{T}{T_1} = \left(\frac{p}{p_1}\right)^{\frac{(k-1)\ m}{k\ (1+m)}} \qquad (5)$$

where k = c_p/c_v, the ratio of specific heats of the gas over the temperature range; m = average value of effective resistance ratio over the nozzle length; T and p are temperature and pressure of the gas.

The MHD nozzle will have a converging approach section preceding the magnetic field to increase gas velocity to near sonic flow. As the gas enters the magnetic field the square-shaped divergent section is sized to maintain constant gas velocity. But flow in the divergent section will be supersonic at all points because temperature drops with distance.

Pressure drop of the gas flowing through the magnetic field is:

$$p_1 - p = \sigma\, v_g B^2 X/g_c(1 + m) \qquad (6)$$

where X is the length from the point of entry into the field. The total MHD nozzle volume can be figured from equation (7), bottom of page, where L = nozzle length, M = mass gas flow.

Fluid friction. Flow at Reynolds numbers up to 10^9 through MHD nozzles over 100-ft long may approach fully turbulent flow characteristic of pipelines. To account for this, equation (5) may be modified to the form of equation (8) below, where f = friction factor, D = diameter of nozzle.

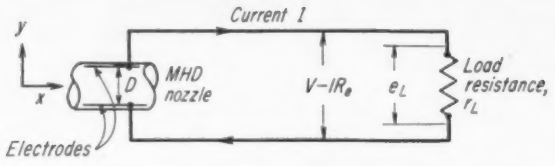
Taking friction and other losses into account we can figure pressure drops in an MHD nozzle by equation (9), bottom of page.

Steps to designing an MHD nozzle: (1) Choose nozzle inlet and outlet pressures, entering temperature, roughness ratio, resistance ratio, magnetic-flux intensity and total power to be generated. (2) From thermodynamic properties and gas conductivities figure convergent-nozzle section to establish gas pressure,

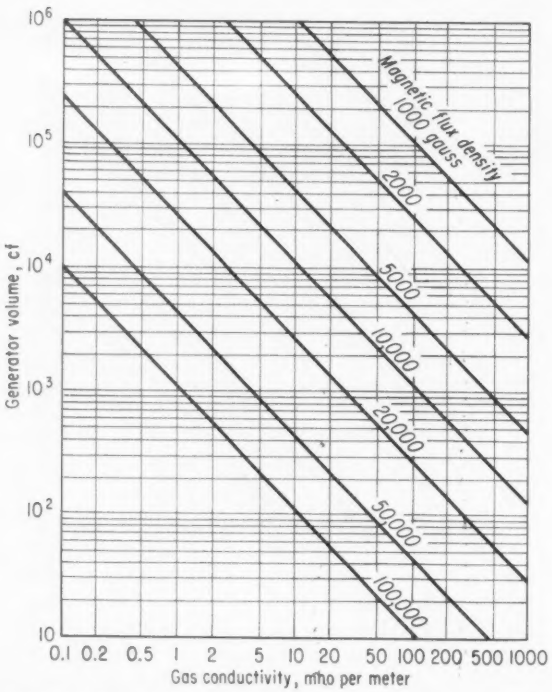
$$V = \frac{MT_1c_p(1+m)^2}{\sigma\, v_g{}^2B^2m}\left[1-\left(1-\frac{kR\sigma v_gB^2L}{(k-1)\ (1+m)\ c_pp_1}\right)^{\frac{(k-1)\ m}{k\ (1+m)}}\right] \qquad (7)$$

$$\frac{T_2}{T_1} = e^{\frac{2fv_g{}^2mL}{c_p(1+m)DT}} \times \left(\frac{p_2}{p_1}\right)^{\frac{(k-1)m}{k(1+m)}} \qquad (8)$$

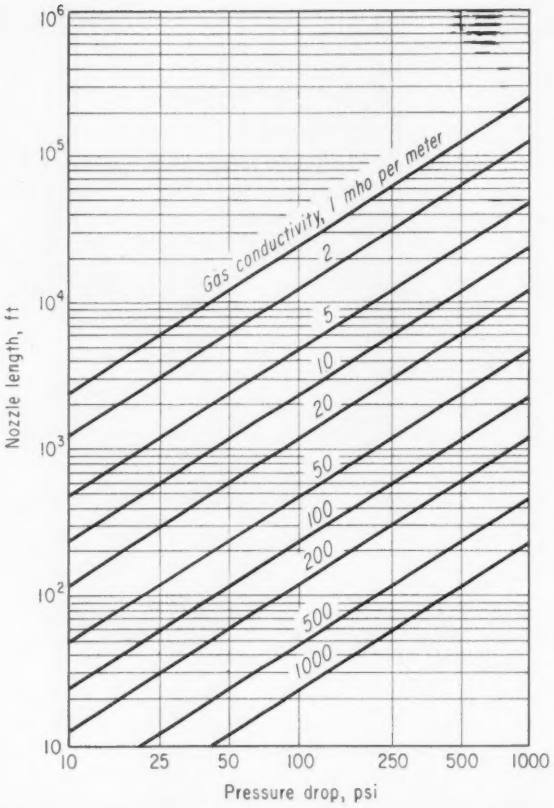
$$p_1 - p_2 = L\left[\frac{\sigma\, v_gB^2}{g_c(1+m)} + \frac{2fv_g{}^{5/2}p_1{}^{3/2}[1-(p_2/p_1)^{3/2}]}{M^{1/2}R^{3/2}g_cT_1{}^{3/2}[1-(T_2/T_1)^{3/2}]} + \frac{3fv_g{}^{5/2}p_1{}^{3/2}\left[(p_2/p_1)^{3/2}-(T_2/T_1)^{3/2}\right]}{M^{1/2}R^{3/2}g_cT_1{}^{3/2}\quad[1-(T_2/T_1)^{3/2}]^2}\ln\frac{T_1}{T_2}\right] \qquad (9)$$



3 MHD generator produces medium-voltage direct current that can be used in simple circuit. Load could be a dc-ac inverter



4 Ideal 250-mw MHD-unit volume depends on flux density and gas conductivity; curves for gas vel of 3280 fps, res ratio of 10



5 Ideal MHD nozzle length depends on gas conductivity and pressure drop; gas vel = 3280 fps, flux = 10,000 gauss, ratio 10

temperature, velocity and mass flow entering magnetic field. (3) Estimate an effective average gas conductivity over the pressure and temperature range in the MHD nozzle. (4) Estimate power density to load, nozzle inlet area and volume. (5) Estimate friction factor to establish temperature ratio and MHD-nozzle length. These give thermodynamic conditions at nozzle outlet and an estimate of (a) nozzle outlet area and (b) amount of entering energy converted to electricity.

To figure the thermal efficiency we calculate: (1) internal energy recovery from kinetic energy of MHD-nozzle exhaust (2) heat transferred to incoming pressurized air (3) heat added to air by fuel (4) air-compression input (5) amount of energy salvaged by the expansion turbine.

The topped plant of Fig. 2 involves the same calculations except that (1) fuel-air ratio is kept near the ideal (2) preheater exhaust gas enters furnace of the steam generator at high temperature.

We get maximum power density and minimum nozzle length when the gas velocity is held at maximum. Instead of using an expansion turbine we can elect to (1) dissipate the kinetic energy as temperature rise in the preheater to be recovered as heat (2) use a longer nozzle in which gas velocity decreases and convert kinetic energy to electricity (3) run the nozzle at outlet pressure below atmospheric with pressure recovery to atmospheric in a diffuser. The last may be the best since the theoretical efficiencies equal or slightly better the best obtained with the expansion turbine—practice may prove this out.

Fig. 4 shows the MHD-nozzle volumes needed for an ideal 250-mw unit. These are based on equation (3) with zero fluid friction, $m = 10$ and $v_g = 3280$ fps. At practical magnetic-flux density of 10,000 gauss and gas conductivities of 50 to 100 mho per meter (with potassium seeding), nozzle volumes of 1100 to 2200 cu ft are indicated; fluid friction increases these volumes.

Fig. 5 gives corresponding ideal nozzle lengths—these do not depend on plant size. Plot is based on equation (6) for $B = 10{,}000$ gauss, $v_g =$

How MHD cycle performs for frictionless nozzle and no heat losses

Main cycle conditions	Case I	Case II
Nozzle inlet pressure, atm	10	30
Nozzle throat pressure, atm	5.8	17.3
Nozzle inlet temperature, F	4500	5040
Nozzle throat temperature, F	4140	4675
Nozzle velocity, ft per sec	3060	3290
Nozzle outlet pressure, atm	1.0	1.0
Nozzle outlet temperature, F	3140	3170
Pressure after kinetic-energy recovery, atm	1.95	2.2
Temperature after kinetic-energy recovery, F	3600	3610
Magnetic-flux density, gauss	10,000	10,000
Gas conductivity, mho per meter	100	100
Resistance ratio, load: internal	10	10
A—Independent MHD unit		
Preheated-air temperature, F	3500	3510
Fuel-air ratio, stoichiometric %	60	98.5
Load power per sq ft nozzle throat, mw	70.2	364
Load-power density, kw per cu ft of nozzle	203	235
Nozzle length, ft	187	594
Spent MHD-gas temp after heat exchange, F	1160	1450
Air compression, % of net power	38	25
MHD efficiency without expansion turbine, %	44.4	52.8
MHD efficiency with expansion turbine, %	51.3	59.2
B—MHD-topped conventional plant		
Preheated-air temperature, F	1900	3460
Fuel-air ratio, stoichiometric %	100	100
Load power per sq ft nozzle throat, mw	70.2	364
Load-power density, kw per cu ft nozzle	203	235
Nozzle length, ft	187	594
Spent MHD-gas temp after heat exchange, F	2520	1520
Air compression, % of net power	17	20
MHD efficiency without expansion turbine, %	51.6	64.7
MHD efficiency with expansion turbine, %	53.9	67.2

3280 fps, $m = 10$. With $\sigma = 100$ mho per meter and 100 to 200 psi drop the lengths run 250 to 500 ft.

This indicates an average nozzle area of 4.4 sq ft and 2.1-ft average diameter for the 250-mw plant. Extremely high magnetic-flux densities and higher gas conductivities are needed to reduce nozzle lengths to more reasonable values and maintain required pressure drop.

Nozzle lengths may be shortened by reducing the resistance ratio m or by raising fluid friction, but then hydraulic efficiency drops. Nozzles should be short since magnetic-field coils must cover entire length and ohmic losses and nozzle heat loss may be appreciable for this reason.

Performance, see table, of Fig. 1 cycle is given for assumed conditions. In Case I these were: (1) no fluid friction (2) liquid fuel $(CH_2)_x$ with HHV of 19,150 Btu per lb (3) 97% flow efficiency of convergent nozzle (4) kinetic-energy recovery at 90% hydraulic efficiency (5) terminal difference of 100 F, 5-psi drop in both sides of preheater (6) 2-stage air compression to 10.35 atm at 90% hydraulic efficiency and 90% motor efficiency (7) expansion-turbine energy recovery at 90% hydraulic efficiency.

A nozzle of 1.0-sq-ft area at throat tapering to 4.4-sq-ft outlet (350 cu ft) produces 70-mw load. Nozzle is 187-ft long and generates about 22-v dc to load per in. of electrode spacing. These calculations used air-enthalpy data based on dissociation equilibrium constants and combustion-product thermodynamic properties given by Hottell, William, and Satterfield in *Thermodynamic Charts for Combustion Processes.*

Table also shows results for a topped cycle of Fig. 2, same conditions assumed above with additional data: (1) conventional-plant efficiency is 35% (2) 27% of heat added to ionized gases is directly converted in MHD unit. Air compression absorbs a total of about 17% of the net power generated, in this case.

Case II of the table gives results for both cycles of Fig. 1 and 2 when nozzle conditions are raised to 5040 F and 30 atm at the inlet. The nozzle must be about 595-ft long. With a 1.0-sq-ft throat the nozzle would taper to 12.2-sq-ft outlet (1550-cu-ft volume) and generate 364 mw at 23 v per in. of electrode spacing. The 3-stage air compression takes about 25% of net power.

Losses will decrease performances listed in the table. Rising resistance ratio will cause greater reheat through ohmic losses. Fluid friction may be high in small-diameter long nozzles. For a friction factor $f = 0.0027$ (typical of 12- to 18-in-dia pipelines) in Case I of the table: (1) the outlet temperature rises from 3140 to 3380 F (2) nozzle length shortens from 187 to 100 ft (3) volume drops from 350 to 275 cu ft and generation from 70 to 56 mw (4) thermal efficiency of cycle in Fig. 1 drops to 32% and 40% with and without the expansion turbine (5) for Fig. 2 it drops to 46 and 48% without and with an expansion turbine respectively.

Practical-MHD-plant development poses many problems in high-temperature technology. Heat exchange materials must withstand 5- to 10-atm pressure differentials at temperatures up to 3000 F. Nozzle and electrode materials must be able to work at 4000 F and higher. Ways of increasing electrical conductivity of ionized gases must be found; areas of investigation include: (1) addition of materials such as potassium and possibly sodium and cesium (2) generation of shock waves in the gas. Alternative methods may be: (1) use of atomic radiation in the MHD nozzle and (2) direct application of MHD to a gas or oil flame.

New look in electric generators takes form as they fill special needs. Active research and development coupled with specialized industrial and military expansion opens fresh fields and spurs search for new and better materials as . . .

PRODUCTION LINE OF THERMOCOUPLES turned out thousands of units for 5-kw thermoelectric generator built by Westinghouse Electric Corp for Bureau of Ships, U.S. Navy

Thermoelectric generators take on

The "better mousetrap" story still holds true: dream up an improvement on an old gadget, show that it works, and spots to put it to work don't take long in coming. In the mid 1940's thermocouples using new semiconducting materials showed a remarkable improvement in thermal efficiency over the well-known thermocouples used for more than a century in temperature measurement. This raised the hopeful prospect of generating electric energy directly from heat without using moving machinery, fluids and heat exchangers.

Today, about $20 million spent annually for R&D begins to pay off. Several manufacturers offer units to do special low-power jobs—navigation lighting, cathodic protection of pipelines, valve control, control-system power sources, microwave and telephone relay equipment, auxiliary drive for gas-fired heating furnaces.

Photo, above right, shows the space-heating-furnace application being developed by the C A Olsen Manufacturing Company. This gas-fired forced-air furnace has four thermocouple modules fitted into the wall of the combustion chamber. Each module measures $8\frac{1}{4} \times 4\frac{1}{4} \times 2\frac{1}{2}$ in., has 47 couples with the hot ends forming part of the combustion-chamber wall. Fins on the cold ends, seen in the photo, are cooled by incoming circulating air that carries the heat into the living spaces served.

The 4-unit generator produces a total of 130 watts at about 9 volts. Electric output powers the air-circulating blower and eliminates the need for separate electric-utility service for the furnace. When the furnace starts running, power from the generator builds up with increasing furnace heat release, starting the blower at low speed and gradually revving it up. Heated-air delivery to the rooms increases slowly in velocity and temperature until reaching steady maximum furnace rating.

Separately fired small units are on the market; photo at left on facing page shows four currently offered by Westinghouse Electric Corp. These units can burn gasoline, propane or natural gas for heat production. To carry off the unavailable heat, forced-air circulation, water or natural-convection air can be used. Depending on the fuel burned the hot sides of the generators run at temperatures between 550 and 1100 F.

Costs of thermoelectric generators have come down quickly. J D Richards of Minnesota Mining and Mfg Co shows a comparison of energy costs for a variety of small power generators, graph at right. This is based on continuous operation for 8760 hours per year with the assumed lives shown, and at present cost levels. Where utility service is not available the thermoelectric generators show economic advantage for 0.1-to-100-w units. Mass production of thermoelectric generators in the near future is expected to show further marked reductions in energy costs.

Thermoelectric generators have this disadvantage: they give poor voltage regulation under varying loads. The remedy involves having the

THERMOELECTRIC GENERATORS with 5-, 10-, 50- and 100-w ratings produce dc at 1.7, 3.4, 4.7 and 9.4 v with a variety of fuels

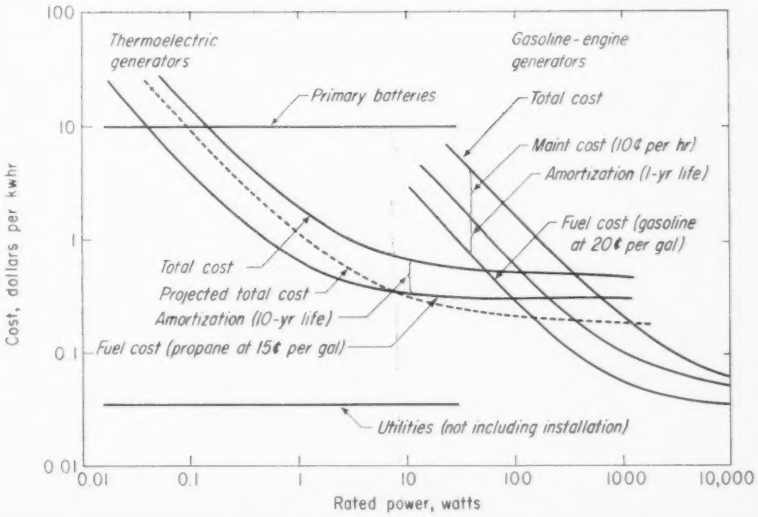
GAS-FIRED FURNACE has four assemblies of thermocouples in furnace wall, produces total of 130 w at 9 v to drive the air fan

new loads

generator charge a storage battery that supplies the load. This has been field tested in a unit for navigation lighting, proved more economical than present methods of supplying electric energy, despite extra cost of the storage battery in the circuit.

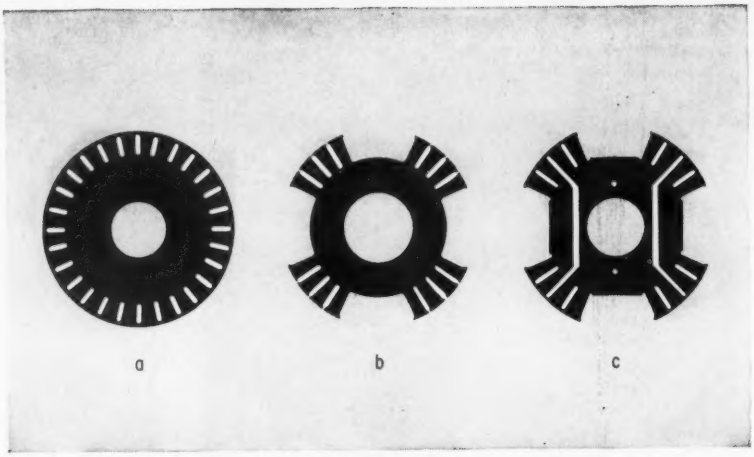
Using essentially the same materials and feeding electric energy to these couples supplies good refrigeration for limited space. Many applications are being developed—in fact, the thermoelectric approach is the *only* way to provide cooling for some equipment situations.

Simplicity of arrangement, compactness, light weight, long life and good efficiency promise a growing demand for thermoelectric devices in both generating and cooling applications. Manufacturers are pushing research programs to develop new materials that will increase the effective temperature range over which thermoelectric generators can work efficiently. For your next low-energy-project study, include thermoelectric generators.



COMPARISON OF ENERGY COSTS shows that thermoelectric generators produce competitive power for low capacities when utility power is unavailable; plant factor = 100%

By NORMAN PEACH
Associate Editor



ROTOR-CORE laminations are punched differently for (*a*) induction motor (*b*) older type reluctance motor and (*c*) improved reluctance motor. Note latter's internal flux paths

Do you cast an envious eye at the induction motor's simplicity, lower maintenance and lower cost when you need a set speed? If so, look hard at the improved . . .

Constant-speed reluctance motors

Reluctance motors, in integral sizes, are constructed much like induction motors but have the constant-speed characteristics of synchronous units. Reluctance-motor principle is not new, but recent years have given it new adaptations making larger sizes and better performance possible. It's still under development.

Motors' 3-phase stators are conventional. The rotors, however, are modified to produce salient poles. Early reluctance motors (*b* in sketch above) simply cut away portions of the rotor iron. These machines produced synchronous speed but required oversize frames and had poor characteristics and high inrush current. Modern reluctance motors (*c* above) have rotor cores carefully designed for best flux distribution.

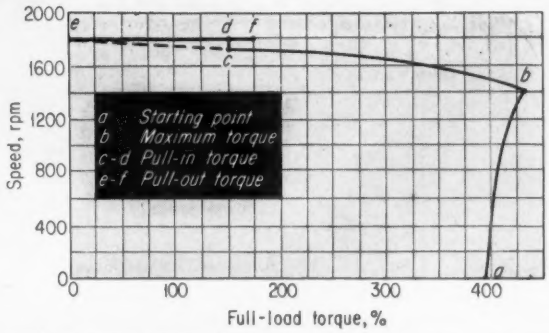
Normal synchronous motors with energized salient poles have a torque component contributed by the pole saliency (nonuniform magnetic circuit) as well as by the dc-energized poles. This torque is produced in the reluctance motor by the salient-pole construction of its rotor. Starting torque is supplied by the squirrel cage, which stops operating at synchronous speed. The salient poles present a low-reluctance path to the direct-axis flux and interpole spaces present a high-reluctance path to the quadrature-axis flux. Latter is suppressed and the rotor locks into synchronism with the main-axis flux.

Synchronous-induction motors of today are reluctance motors with greatly improved rotor design. Improvements are brought about by punching the rotor laminations to make internal high-reluctance paths that further concentrate rotor flux at the salient poles. The rotor bars, end rings and ventilating fans can be then die-cast of aluminum, like induction-motor rotors. Die-cast metal fills all voids in the rotor, including the interpole spaces, resulting in a cylindrical rotor looking substantially like a squirrel-cage induction rotor. It has been possible to build a complete 60-cycle line on induction-motor frames.

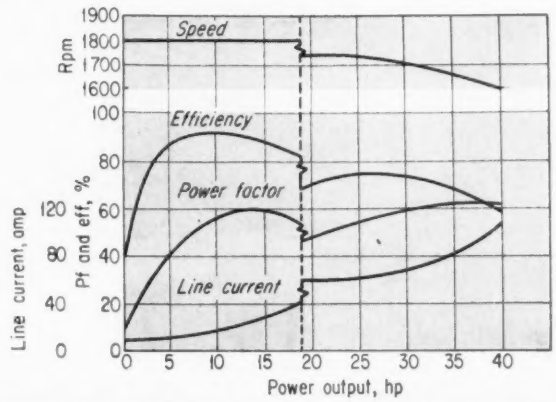
Speed-torque curve for typical synchronous-induction motor is shown on next page, top left. Buildup to synchronous speed is same as induction motor's; starting torques for normal-inertia loads are on the order of 350 to 550% of full-load running torque. Pull-in torque depends on connected load and load inertia. Pull-out torques range 110 to 140% of full-load torque. When motor load exceeds pull-out torque, units will operate as induction motors—but ordinarily they are not designed to operate beyond pull-out more than momentarily.

Torque angle, as applied to synchronous-induction motors, is shown in sketch, top right. As with excited synchronous machines, torque angle is defined as the angle between terminal-voltage axis and rotor-pole axis. With no torque requirements, practically the case at no load, the two axes coincide and represent the axis of the magnetic flux. As torque is required, the rotor-pole axis lags behind the terminal-voltage axis until at full load there's an appreciable torque angle. Different loads will have different torque angles. Speed is constant with line-voltage variations of $\pm 10\%$.

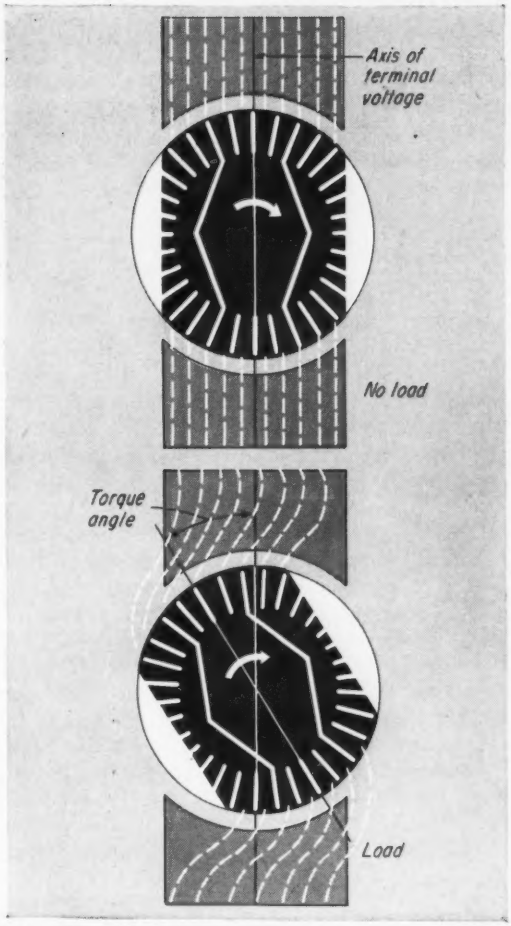
Efficiency for a typical 20-hp 3-phase 1800-rpm motor is 88%, about the same as for an energized synchronous motor (1.00 pf) and induction motor, and compared with 79% for a comparable old-style re-



TYPICAL SPEED-TORQUE CURVE shows starting characteristic of an induction motor, then pulls into its synchronous speed at point *c*



PERFORMANCE CURVES for typical 10-hp 4-pole 440-volt synchronous-induction motor. This motor pulls out of step at about 18 hp



TORQUE ANGLE of rotor varies with torque demands load makes on motor—from min at no load to max at pull-out

luctance motor. Power factor is about 0.60 compared with 0.88 for induction motors and about 0.38 for older reluctance types. Inrush currents are relatively high: 750 to 1200% of full-load currents. Reduced-voltage starting often is used.

Applications for these improved reluctance motors include both constant- and adjustable-speed drives, ranging up to 50 hp. Above 50 hp, energized synchronous motors are generally more desirable. Among constant-speed applications, generator drives are important, especially at 400 cycles or other high frequencies. Motors have been used for 60-cycle generators to maintain constant-voltage output from supply systems with stable frequency but varying voltage.

Other constant-speed applications are in automatic or semiautomatic processes where a particular operation must synchronize with those which precede and follow. Positive-displacement metering or proportioning pumps are another possibility: amount of liquid pumped would remain constant regardless of changes in motor load because of variations in liquid viscosity.

Adjustable-speed applications use an adjustable-frequency power source. Several motors in a process can be made to change their speed simultaneously when the frequency is adjusted (see *Today's Development* report on adjustable-speed drives in POWER, July 1960, pp 63-68). Speeds of individual motors may differ according to the ratio of the number of poles for which they are wound, but each will operate at its synchronous speed as determined by the frequency.

Control-system components may be synchronous-induction motors where the input frequency is a signal generated by the quantity to be controlled. One such application: a governor drive for the inlet valve of a water-wheel generator.

Competition for the improved reluctance motors can be expected from new designs of excited synchronous motors that operate without conventional dc exciter, slip rings and starting gear. Rotor-mounted rectifiers supply excitation and silicon-controlled rectifiers, also on the rotor, provide automatic synchronization.

Steps going up? Design them for

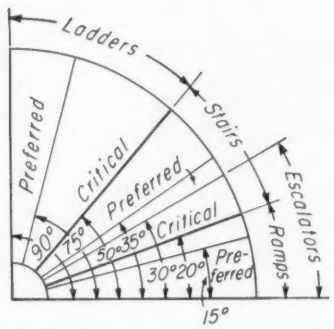
Heavy machinery of the sort included in most energy systems must have access by ramps or ladders. Main problem involved in their design and use is one of adequate clearance and provision for handrails where needed. Is your installation up to snuff for safety and convenience? Here are recommended design standards for clearances and safety devices—information for building adequate stairways, ladders, platforms, etc for large machines including cranes, turbines and fans. Look around your powerhouse. There may be many other places where layout of ramps and ladders can be improved—possibly averting a nasty accident.

Much of this material comes from government publications, especially those of the Bureau of Reclamation. Other codes are cited where applicable.

Ramps steeper than 10% require nonslip surfaces and handrails. Most codes limit the pitch to about a 2:12 maximum, 16.67%. Overhead clearances and handrail heights may be determined graphically from the diagram below.

Stepladders require handrails on both sides when not confined between walls, or when risers are closed in. When risers are open, treads or the ladder frame may serve as handholes. Regardless of open or closed construction, handrails should be provided if possible.

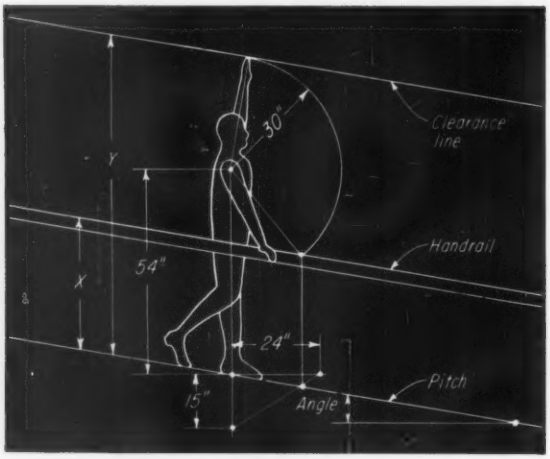
Rung ladders should have round rungs if possible to provide maximum kneeroom. Rungs need not be evenly spaced between floors, but irregular spaces should be planned so they occur at the lower landing for safety.



USE CRITERIA for ladders, stairs and ramps depends on pitch angle between terminal points. Most applications should follow the preferred angles. Many building codes forbid exceeding critical values

Application of ramps vs ladders hinges on pitch. Ramps are lower in pitch than 20 deg, with handrails required for steeper pitches. Stepladders are lower in pitch than 75 deg and require flat treads. Risers may be either open or closed. Handrails may or may not be included. Rung ladders are pitched steeper than 75 deg, require extremely narrow treads or round rungs to provide kneeroom but do not require additional handrails. Diagram above indicates critical and preferred angles for each of the three categories.

Ramps range in pitch from 0 to 20 deg, may require handrails



Pitch, ratio	Gradient: Grade, %	Gradient: Angle, deg — min.	Handrail height X, in.	Clearance Y, in.
½ : 12	4 1/6	2 — 23	35	84
½ : 10	5	2 — 52	35	84
1 : 12	8 1/3	4 — 46	34½	84
1 : 10	10	5 — 43	34½	84
1 : 8	12½	7 — 7	34	84
1½ : 12	12½	7 — 7	34	84
1½ : 10	15	8 — 23	34	84
2 : 12	16 2/3	9 — 28	34	84
2 : 10	20	11 — 19	34	84
2½ : 12	20 5/6	11 — 46	33½	85
2½ : 10	25	14 — 2	33½	85
3 : 12	25	14 — 2	33½	85
3½ : 12	29 1/6	16 — 16	33½	85
3 : 10	30	16 — 42	33½	85

Maximum pitch

1. Values below the dotted line in chart, above right, are prohibited by the New York City Building Code for access aisles. One exception: runs not exceeding 10 ft may be pitched a maximum of 1:8
2. Values below the dashed line are prohibited by most other building codes
3. All values above the solid line are approved by the Workmen's Compensation Service Bureau

Minimum width

1. For single-file traffic: 30 in.
2. For furniture passage: 36 in.
3. Preferred single-file minimum: 42 in.
4. Access aisles: 36 in., increasing 1½ in. every 5 ft of run

safety and convenience

By H W HAMM

Stepladders, 50 to 75 deg, are installed with or without handrails

Step dimensions		Gradient		Clearance	Handrail height
Riser R, in.	Tread T, in.	Grade, %	Angle, deg — min.	Z, in.	X, in.
9⅜	7½	125	51 — 21	64	34½
9¾	7	139.28	54 — 19	62	34½
10⅛	6½	155.75	57 — 18	59	35
10½	6	175	60 — 16	57	35
10⅞	5½	197.72	63 — 10	54	35½
11¼	5	225	66 — 2	52	35½
11⅝	4½	258.66	68 — 50	50	36
12	4	300	71 — 34	47	36
12⅜	3½	353.21	74 — 12	45	36½
12¾	3	425	76 — 46	42	37

Handrails are required on both sides of stepladders, unless risers are left open or ladders are confined between side walls

Maximum and minimum widths:

With handrails: 21 to 24 in.

Without handrails: variable

Between side walls: 24-in. minimum

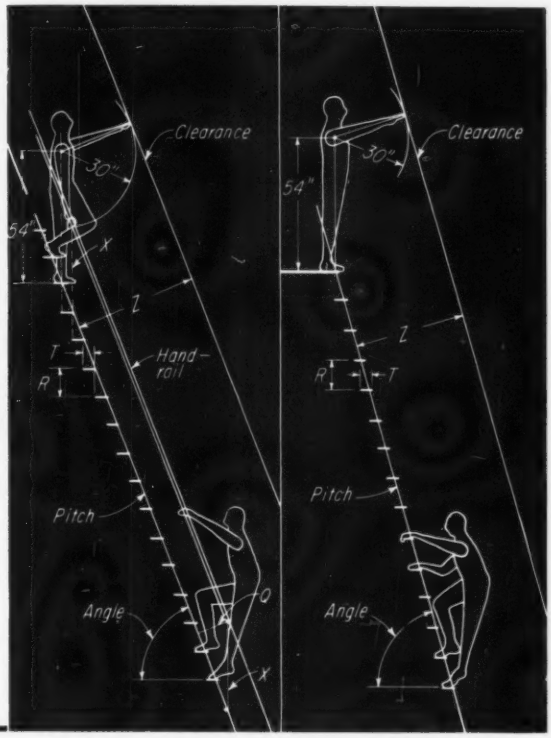
For fire escapes, etc, consult building codes and fire regulations

Formulas

Tread, $T = 20 - 4/3\ R$ Riser, $R = 15 - 3/4\ T$

Perpendicular distance, Q, pitch line to handrail:

$$Q = X \div \sqrt{(R/T)^2 + 1}$$



Rung ladders may range from 75-deg incline up to vertical

Pitch, ratio	Gradient: Grade, %	Gradient: Angle, deg — min.	Rung spacing S, in.	Clearance Z, in.
12 : 2½	480	78 — 14	13¼	41
12 : 2	600	80 — 33	13½	39
12 : 1½	800	82 — 53	13¾	37
12 : 1	1200	85 — 14	14¼	35
12 : ½	2400	87 — 37	14½	32
	Vertical	90 — 0	15 max / 12 min	30

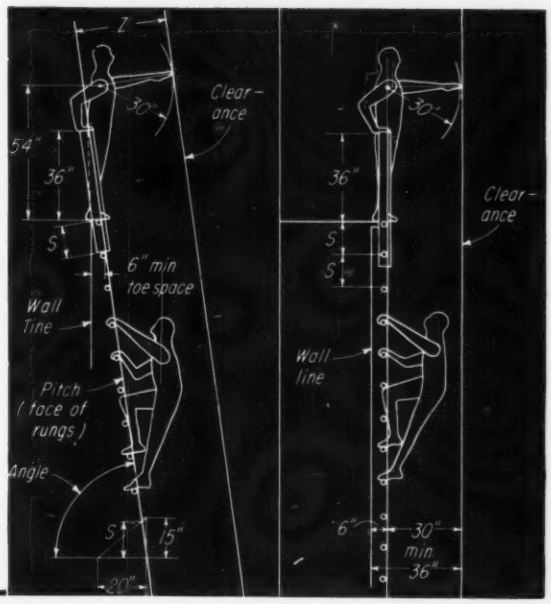
Ladder frame should extend 3 ft above platform

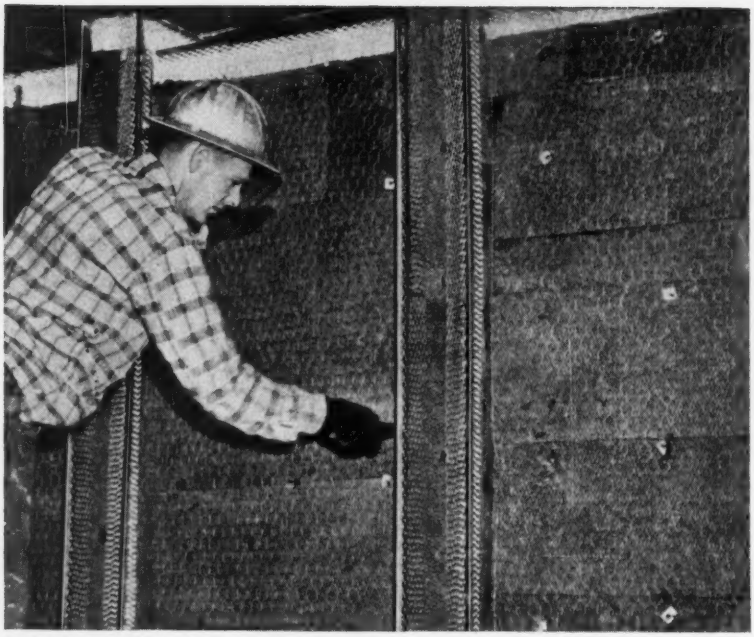
Widths:

Minimum: 15 in.

Desirable: 18 in.

Minimum between side walls: 24 in.





RESILIENT INSULATION simplifies installation, cuts hand trimming around studs

Florida Power and Light cut boiler-insulation costs by tracking down new materials which . . .

Match insulation to equipment needs

Selecting thermal insulation for power-plant applications involves a careful balancing of material properties to obtain minimum first cost and operating expense. In many cases this means finding a material with a use limit close to, but above, your operating conditions.

When FP&L designed their latest station, they found one insulation-application area where they could save money and at the same time do a better job of meeting use limits. Maybe this application could save you money, too. Here's the story:

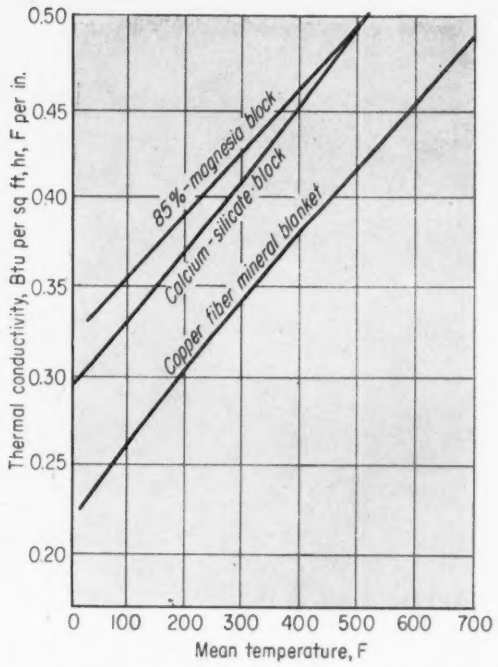
For many years the greater part of insulation for boiler furnace walls, convection passes, gas and hot-air ducts has consisted of 85%-magnesia block. Block was usually strung over spikes, held in place by washers and then laced with wire between spikes. Construction of this sort was needed to withstand the combination of high temperatures—up to 1000 F at the hot face—and possible vibration or "working" of insulated parts.

Within the last few years new boiler-construction techniques have changed this picture. Fully water-cooled furnaces, particularly the pressure-fired ones with skin casings, limit hot-face temperatures. Insulation is shielded from direct furnace radiation or contact with hot gases. As a result, hot-face temperatures remain close to saturation temperature for the unit, less than 700 F. This means that conventional insulation exceeds actual temperature-use requirements by some 300 F. So if an insulation with a lower use limit could be found, users might be able to save on material costs.

FP&L got a chance to investigate materials during installation of newly designed full-waterwall boilers at their new high-capacity Port Everglades Station. In the end they rang up substantial savings by using intermediate-range insulation for parts of the steam generators.

When plans were drawn for boilers, designers investigated the possibilities of a lighter-weight dry-process insulation for the system. Since the periphery temperature would not exceed saturated-steam temperatures, costly refractory construction was not required. FP&L asked the engineering contractor, Bechtel Engineering, to make a detailed investigation of a new boiler-insulating material—first studies indicated it had been applied successfully to similar full-waterwall boilers.

Investigation proved the new block highly efficient up to 700 F, well within specifications for the Port Everglades project. Although there was only one supplier of this new type of insulation at that time, utility engi-



Felted fibers have low conductivity

Material characteristics of the mineral-fiber insulation result in improved performance over the intermediate-temperature use range it is designed for. Comparison of thermal conductivities for solid blocks and felted fiber shows lower values for fiber up to mean temperatures of 400 F. This corresponds to a hot-face temperature somewhere around 700 F, depending on cold-face conditions. Reduced thermal conductivity of felted-fiber block may be credited to greater void volume within the structure. New block consists of mineral-slag fibers bonded with high-temperature resin. Resultant block is unaffected by deflection or vibration. Use limit is based on maximum temperature for resin binder.

neers elected to waive competitive bidding in favor of the lower costs. As they expected, several alternative sources are now available.

Immediate savings of several thousand dollars in material costs accrued from their use of the new block, which was at the same time a highly efficient insulation. Thermal conductivity as seen above, right, is lower than that of conventional high-temperature hard-block insulations which exceeded the new requirements.

Application centered on the convection pass and economizer, continued throughout gas-duct and hot-air systems. Each unit required about 45 carloads of insulating material.

Installation was relatively simple and remarkably fast. The new block is semirigid in construction, made of felted, laminated high-temperature mineral fibers and light in weight, so workers could install it in larger sizes than is customary with hard-block insulation.

Blocks were installed on the steel-plate ductwork by impaling them on 12-gage pins which had been welded to the plate. Speed washers were slipped over the pins, and the protruding ends of the pins bent over. This held all block securely in place.

Just before installing the block, shoulder pins were inserted to serve as anchorage for the metal jacket. Galvanized metal was used for the entire system. Since the new block could be penetrated easily by shoulder studs, trimming and fitting of the block was eliminated. This resulted in further installation-cost savings.

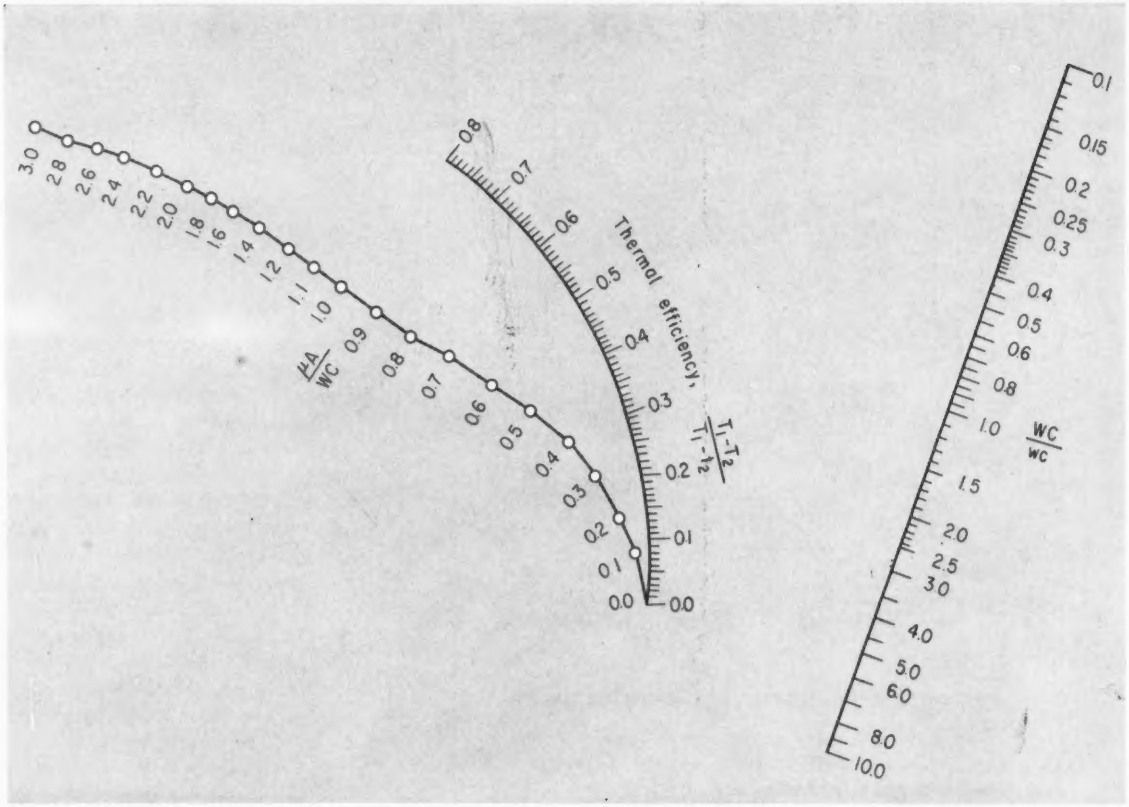
Staying power of the insulation was tested by Hurricane Donna, which interrupted work on the project in early fall, 1960. Winds of 90 mph roared across Florida and caught unit with insulation already pinned to the economizer section and gas duct leading to the air preheater. The outer jacket had not yet been applied so the bare insulation took the brunt of the storm's attack. When calm returned, engineers inspected and found they hadn't lost a single block of insulation. Insulation was all in place and had sustained no damage. This was despite 11 inches of rain poured into the area in a 12-hr period.

FP&L just finished building the second steam-generator-turbine unit at Port Everglades Station. With the completion of two projects and collection of operating records for one unit, they have an excellent check of installation costs and an indication of in-service performance.

A look at costs for the two units indicates savings for users in many areas. To begin with, there is a considerable advantage in material cost. This is coupled with a real reduction in labor man-hours tracing to less hand trimming and cutting to get around pins and shoulder studs. Wire lacing is not required—a time-consuming hand operation that often required expensive nickel-chrome wire.

One final item: flexibility and toughness of this insulation prevents it from breaking down under vibration, and cuts material wastage from breakage during installation or transporting—one problem with the hard block.

This kind of new-material evaluation and careful analysis of needs will pay dividends in all areas of utility-plant design. Keep it in mind when working on your next plant.



PARALLEL-FLOW heat-transfer problems are solved using the nomograph above. First you'll have to calculate the WC/wc ratio and $\mu A/WC$. When plotted on scales, line joining two ratios cuts thermal-efficiency scale at value which supplies temperature T_2

Solve heat transfer by nomograph

By V S GUPTA, Training Officer, Bhilai Technical Institute, India

Calculation of heat-transfer performance is a design problem common to many energy systems. Depending on your particular situation, you may be after a value for proposed heat-transfer surface or actual thermal efficiency of an operating unit.

Nomographs are based on plots of two equations which appeared in an article by I Granet of Foster Wheeler Corp, *Chemical Engineering*, March 1955, pp 187 to 190. For a detailed derivation refer to that article. But to summarize, these are the final equations Granet comes up with:

Parallel flow

$$\frac{T_1 - T_2}{T_1 - t_1} = \frac{1 - e^{-(\mu A/WC)\ (1 + WC/wc)}}{1 + (WC/wc)}$$

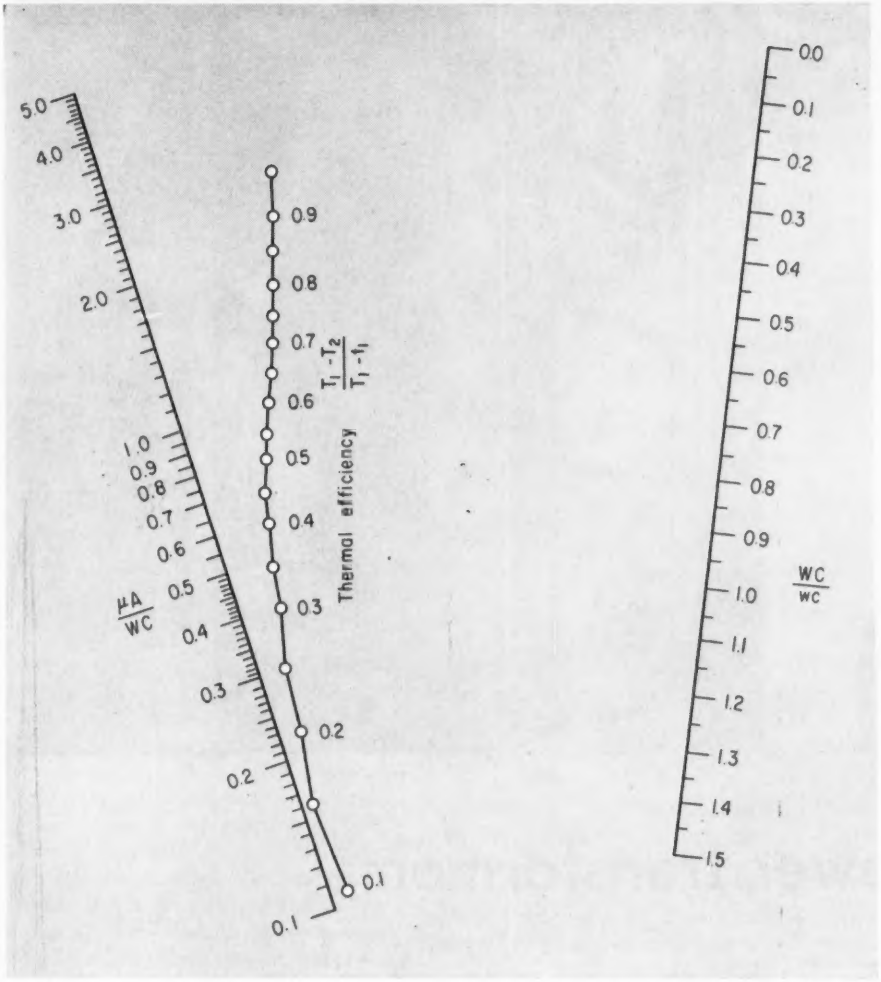
Counterflow

$$\frac{T_1 - T_2}{T_1 - t_1} = \frac{1 - e^{-(\mu A/WC)\ (1 - WC/wc)}}{1 - (WC/wc)\ e^{-(\mu A/WC)\ 1 - (WC/wc)}}$$

Where: W = flow rate of hot fluid, lb per hr
w = flow rate of cold fluid, lb per hr
A = area of heat-transfer surface, sq ft
C = specific heat of hot fluid at constant pressure, Btu per lb, F
c = specific heat of cold fluid at constant pressure, Btu per lb, F
μ = overall heat-transfer coefficient based on outside surface, Btu per hr, F, sq ft
T_1 = temperature of hot fluid entering, F
t_1 = temperature of cold fluid entering, F
T_2 = temperature of hot fluid at exit, F
t_2 = temperature of cold fluid at exit, F

Actual scales are plotted in terms of dimensionless ratios $\mu A/WC$, WC/wc, $T_1 - T_2/T_1 - t_2$, $T_1 - T_2/T_1 - t_1$. Begin by computing two ratios, then solve the third ratio by nomograph. Prior calculation of ratio $\mu A/WC$ and WC/wc permits more-accurate solutions. Several 6-digit parameters included in a graphic solution would require extremely precise readings of points on scales.

Using these nomographs for calculating thermal efficiency lets you find end temperatures with practical engineering precision. Simply calculate the ratio WC/wc. Then, using an assumed or actual area of heat transfer



COUNTERFLOW transfer calculations are handled in fashion similar to parallel-flow nomograph at left. If combination heat-exchanger designs are used, each flow path is calculated separately

plus expected overall heat-transfer coefficient, calculate $\mu A/WC$. Plot the two ratios, draw a line between them and read the intersection of that line and the thermal-efficiency scale. This third ratio may be used to find T_2. Heat balance between the hot and cold fluids calculates t_1 or t_2, assuming negligible heat loss from the unit.

Example: Cold water at 60 F enters a heat exchanger at a rate of 100 cu ft per hr, or 6240 lb per hr. Hot fluid at 500 F enters at 20,000 lb per hr; its mean specific heat is 0.18 Btu per lb, F. If we know the effective area of the heat exchanger is 450 sq ft, how do we determine outlet temperatures for both fluids?

Solution: Assume, for design purposes, that we wish to hold a heat-transfer coefficient of 10. Then the ratios of $\mu A/WC$ and WC/wc may be calculated:

$$\frac{\mu A}{WC} = \frac{10 \times 450}{20{,}000 \times 0.18} = 1.25$$

$$\frac{WC}{wc} = \frac{20{,}000 \times 0.18}{6240 \times 1.0} = 0.577$$

For parallel flow, use the nomograph above, left. Align values for the two ratios and read thermal efficiency of parallel-flow heat transfer as 0.54 from the center scale.

$$0.54 = \frac{T_1 - T_2}{T_1 - t_1} = \frac{500 - T_2}{500 - 60} \qquad \text{So } T_2 = 262 \text{ F}$$

Heat given off by hot fluid:

$$(T_1 - T_2)\ C \times W$$

$$(500 - 262) \times 0.18 \times 20{,}000 = 856{,}800 \text{ Btu}$$

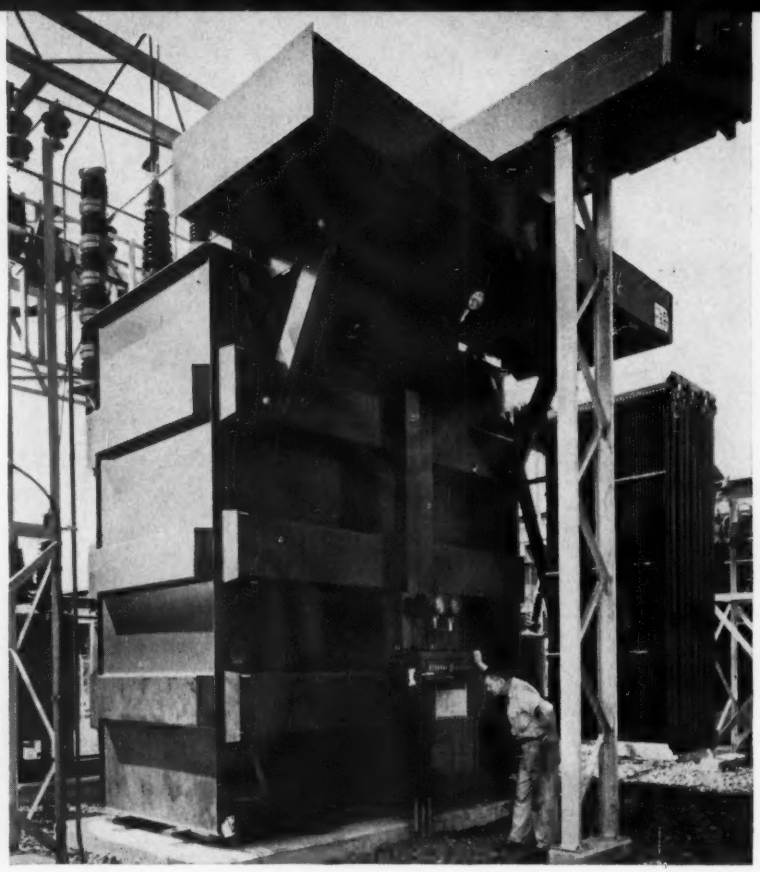
This approximates heat taken in by the cold fluid. Therefore, rise in temperature of the cold fluid is:

$$\frac{856{,}800}{6240 \times 1} = 137 \text{ F}$$

$$t_2 = 137 + 60 = 197 \text{ F}$$

We have found the hot-fluid exit temperature, 262 F, and the cold-fluid exit temperature, 197 F. Similar results could have been obtained for counterflow conditions, using nomograph above, right.

For design problems where heater surface and overall heat-transfer coefficient may be varied, you can enter nomographs with known ratios of WC/wc and thermal efficiency to obtain optimum balance between the surface area and overall heat-transfer coefficient.



UPRATING TO 167% of initial self-cooled capacity is possible for this typical building-block power transformer by adding radiators with fans and oil pumps. Cooling-equipment-control cabinet contains all terminal blocks needed for maximum rating →

By D J THOMAS
General Electric Co

Now available are power transformers fabricated on the building-block principle. Advantages: automated design, repetitive manufacture, an inexpensive way to . . .

Uprate power transformers

Is building-block design the power-transformer trend?

Using standardized, interchangeable components—the building-block technique—has been notably successful with smaller electric apparatus. Since introduced by General Electric, power transformers built on this principle have had good acceptance. But other manufacturers indicate they are not convinced the majority of power transformers can be made this way, at least not for another decade. They cite great diversity of systems above 69 kv, utility companies' internal standards, desire of customers' engineers to participate in design of such large and important units in their systems. But economics of present-day competitive manufacturing and effort toward standardization provide incentives.

Building-block design and manufacturing concept has many ramifications. An important one: a transformer with a given self-cooled rating has exactly the same core-and-coil assembly as a similar forced-cooled transformer with a kva rating equaling 167% of the self-cooled figure. For instance, consider a transformer rated 18,000/24,000/32,000 kva. Designated an OA/FA/FOA transformer, it has a self-cooled rating of 18,000 kva, a forced-air-cooled rating of 24,000 kva and a 32,000-kva forced-oil-cooled rating. The same core-and-coil assembly used in this transformer also goes into a straight forced-oil-cooled (FOA) 32,000-kva transformer of similar voltage rating.

This transformer can be purchased as a self-cooled unit with radiators only, as a forced-air-cooled unit with radiators plus fans or as a triple-rated forced-oil-cooled unit with radiators, fans and oil pumps. In any event, all current-carrying parts such as leads, bushings and tap changers are designed for the maximum rating of 32,000 kva in case it's needed.

Radiators are mounted on end of tank and assembled in two banks. The top header for each bank is attached to a pipe nipple at the top of the tank and the bottom header is attached to a manifold isolated from the main tank. On self-cooled and forced-air-cooled transformers a flanged U-shaped pipe connects the transformer tank and the manifold. For 167% the U-pipe is replaced with a pipe-and-pump assembly.

Three nipples near the top of the tank and three openings in the manifold permit operation with either two or three unit coolers instead of two radiator-bank assemblies. Should the relocation of a transformer limit available floor space, the size of the transformer can be reduced considerably by simply replacing the radiator assemblies with unit coolers and adding the required controls. The 18-mva

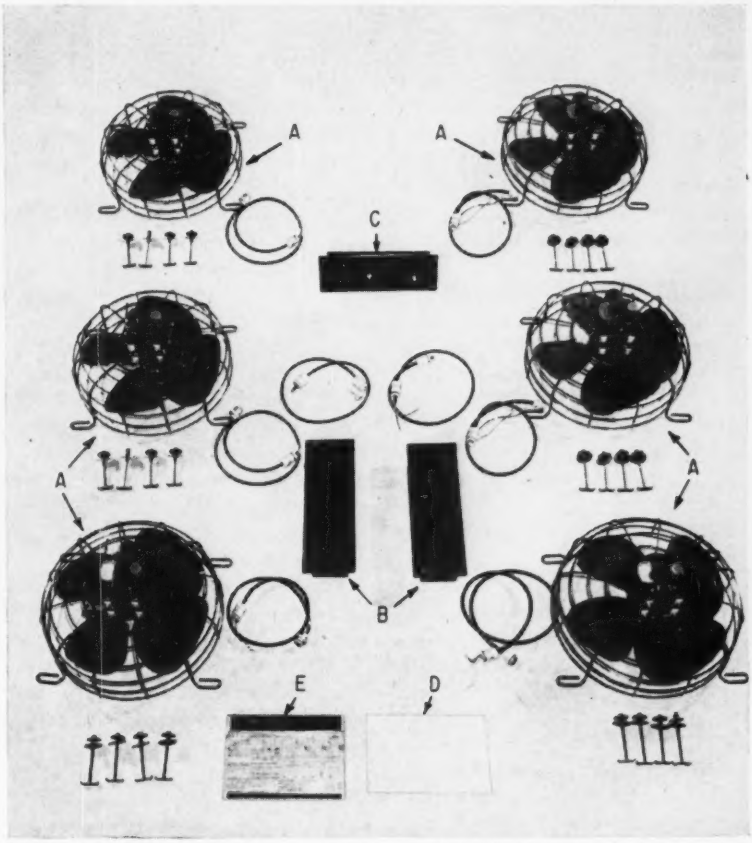
self-cooled transformer in our example would then be a 32-mva forced-oil-cooled unit, the maximum rating.

Standardized cooling-equipment-control cabinet is used for all large substation and transmission-tie transformers. Basic package for a self-cooled transformer includes the control cabinet with all terminal blocks for maximum future rating. If 133% fan-cooled rating is purchased, a hinged frame is included in the housing. A prewired fan-control panel is mounted on the frame and the controls are connected to terminal blocks at rear of the housing. In addition, sufficient space is available on the hinged frame to mount two pump-control panels and another fan-control panel, ready to go to the full 167%. So, the standard 133% hinged frame is designed to hold all fan and pump controls for an OA/FA/FOA transformer or the pump controls for an FOA transformer.

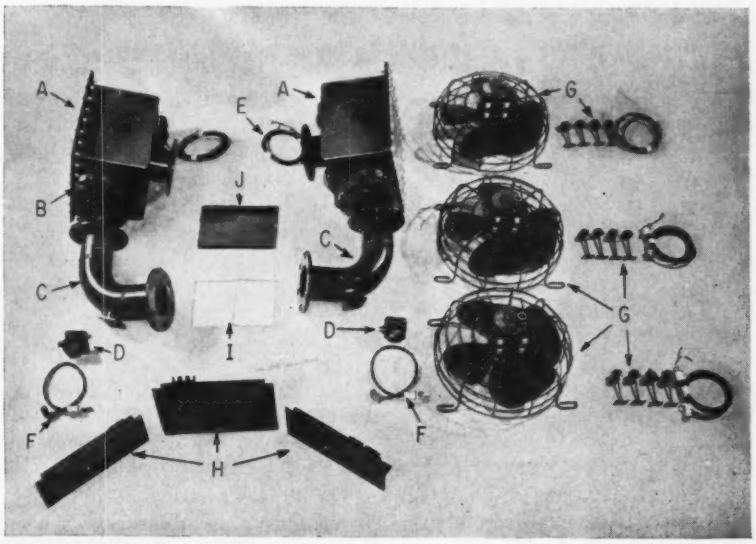
A single conduit run is provided from the control cabinet to a junction box located at the cooling-equipment end of the transformer. All fan, pump and flow-indicator leads are brought to this junction box for easy assembly. Each radiator-bank assembly has predrilled holes on the frame for locating a fan terminal box. All fan leads on each bank are connected to the terminals inside the box. Then a single cable connects each fan terminal box to the junction box on the end of the tank.

These provisions allow uprating a building-block-design transformer quickly and economically. Uprating takes either one or two steps. Material required to uprate a typical transformer to 133% is shown in photo, top right. All parts are shown except terminal blocks for mounting in the tank junction box, control wiring and the hinged control-panel frame. All materials required to uprate the same transformer from 133% to 167% are shown in photo at bottom right.

Benefits of building-block-design power transformers can be appreciated best by comparing steps involved in their uprating with those required to step up conventional designs. With conventional designs, the user generally must estimate capacity he'll



133% UPRATING uses these parts (plus terminal blocks for tank junction box, control wiring, hinged control-panel frame): (*A*) fans, cable assemblies, mounting hardware (*B*) fan terminal boxes, cable assemblies for tank-junction-box connection (*C*) control panel for mounting in control housing (*D*) installation drawings (*E*) new nameplate



BOOST FROM 133 to 167% requires only these parts: (*A*) 2 pump assemblies (*B*) 2 shutoff valves (*C*) 2 pipe elbows (*D*) 2 flow gages (*E*) pump cable assemblies (*F*) flow-gage cable assemblies (*G*) additional fans (*H*) additional control panels for mounting in control housing (*I*) installation drawings (*J*) nameplate to show the increased rating

Basic design eases cooling-equipment changes

want sometime in the future when he first orders his transformer. The initial price then includes an adder for increased capacity of the internal current-carrying parts such as leads and tap changers. Once the decision is made to increase the rating, actual modification is often a time-consuming operation.

Full 133% or 167% uprating is not always available without extensive modification if transformer was not ordered with provision for future capacity. User may run into costly delays while engineering and drafting studies are under way to determine internal and external modifications required.

With building-block design, user need not stipulate any provision for future capacity when he orders the transformer—provision is included automatically. Conversion ease offers additional savings. Estimated time to add accessories for 167% rating to a transformer rated OA-T-60 18,000-kva 115-kv is about 15 man-hours, as against 31 man-hours for conventional designs. Apart from important economies in uprating, design and manufacture of building-block transformers costs less, with resultant savings passed along to the purchaser.

Procedure for uprating a building-block transformer to 133% of initial rating is relatively simple:

(1) Mount the hinged frame, containing prewired panels, in the control housing on transformer tank.

(2) Pull wire for fans and future pumps through the existing conduit.

(3) Connect the prewired control panels to the existing terminal boards in the control housing.

(4) Mount the fan terminal boxes on the radiator-bank frames and connect the cables from the terminal boxes to the junction box on tank end—provided for this purpose.

(5) Add the fan-support bolts to the radiators as specified on assembly drawings.

(6) Install the fans and connect the fan leads to the terminal boxes on the radiator-bank frames.

Several additional operations are required to go from 133% to 167% kva rating:

(1) Close the valves between the tank and manifold pipes and also between the tank manifold and radiator headers for minimum oil handling.

(2) Drain the oil from the tank manifold and the manifold pipes.

(3) Replace the manifold pipes with the pipe-and-pump assembly shown in photo at right, below.

(4) Install additional fans and connect leads to fan terminal boxes.

(5) Add the pump-control panels and the additional fan-control panel to the hinged panel frame.

(6) Connect oil-filling hose to filter-press valve and fill the manifold until oil flows from the vent plug on top of the manifold.

(7) Open the bottom radiator valves and vent the radiators.

(8) Open the tank manifold valves to permit circulation.

Similarly, the transformer can be changed from a triple-rated unit with fans and pumps to a forced-oil-cooled unit with finned cooling tubes in simple steps:

(1) Close the valves between the tank and manifold pipes and also at the top radiator headers.

(2) Drain oil from radiators and manifold.

(3) Replace the manifold pipe-and-pump assemblies with manifold pipes (reverse of steps shown in photos).

(4) Remove the radiator-bank assemblies.

(5) Add coolers and pumps.

(6) Connect pump and flow-gage leads to junction box at tank end.

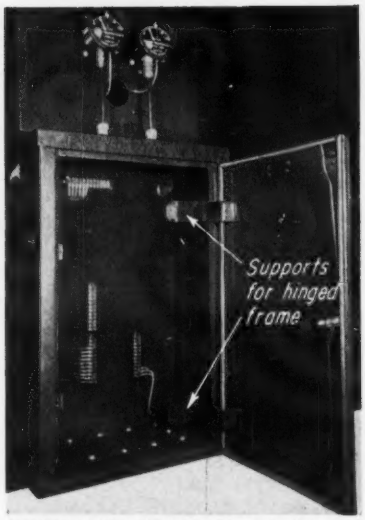
(7) Replace fan-control panels with cooler-control panels.

(8) Fill manifold and coolers through the filter-press valve until oil flows from all vent openings on the manifold, pumps and coolers.

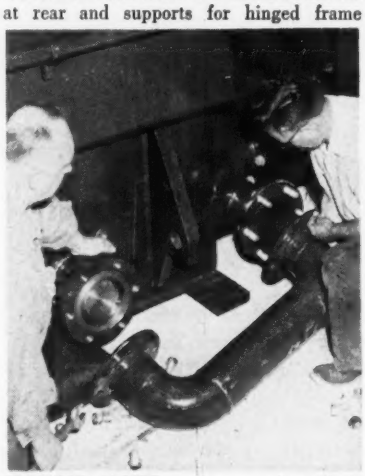
(9) Allow the transformer to stand three or four hours, then repeat venting.

(10) Open all valves and energize the transformer.

On the basis of these step-by-step procedures you can make your own estimates of man-hours involved in increasing transformer ratings. Work can be done by the same men who normally service your transformers.



CONTROL HOUSING has terminal blocks at rear and supports for hinged frame

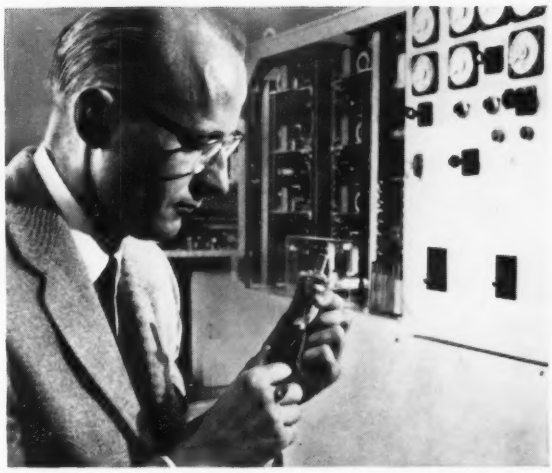


FLANGED U-PIPE connects tank and oil manifold on self- and forced-oil-cooled units

PIPE-AND-PUMP assembly is easily installed in place of U-pipe for 167% rating

Newcomers on the scene: high-powered experimental rectifier and inverter units slated to help . . .

Silicon-controlled rectifiers get ready for industry



INVERTER uses silicon-controlled rectifiers, gives 50 to 500 cps

RECTIFIER supplies 1200 amp continuously, 2400 amp for 10 sec

A high-capacity solid-state-electronic device for converting dc to ac was recently revealed. Developed by General Electric Company's General Engineering Lab, the inverter is rated 50 kva, which is 10 times the power-handling capacity of units of this type so far announced.

New inverter is expected to help solve what has been a difficult problem in development work on new power sources. While electric power generated by means such as fuel cells is always in the form of direct current, most applications require that this be inverted into alternating current—and at relatively low cost.

Many jobs for electricity produced by the new power sources are expected in situations where m-g sets, normally used for inversion, would be unsuitable. Extremely low maintenance is foreseen for the inverter since it has no moving parts other than two fans. This would make it useful in isolated, unattended locations.

Inversion from dc to ac is accomplished by silicon-controlled rectifiers which operate instantaneously and need no warmup. Compared with other solid-state devices such as transistors which might be used for inversion, silicon-controlled-rectifier (scr) cells show best promise for economical and high-capacity operation, according to GE engineers who developed the inverter.

Ac-power output is 50 kva, with adjustable frequency from 50 to 500 cycles, 120 to 240 volts, 3 phase. Accuracy is ± 1% of voltage and ± ½% of frequency. Sinusoidal output wave form has less than 5% total harmonics. As an input, direct current at 125 volts is utilized.

Unit consists of two 12-phase bridge inverters. Output voltage of each of these inverters can be varied in phase, with respect to one another, to control total output voltage. This scheme provides excellent output wave form. Output frequency is determined by a unijunction oscillator which fixes inverters' gating rate. Scr cells used in the 50-kva unit are rated 50 amp each. Overall efficiency of the inverter is anticipated at over 80%. Efficiency of scr elements in this installation should exceed 95%.

New 300-kw rectifier uses scr cells

A high-powered experimental rectifier for industrial purposes, recently announced by Westinghouse Electric Corp's rectifier and traction-equipment department, uses high-current silicon-controlled rectifiers called *Trinistors*. The 300-w unit will help determine feasibility of employing these scr devices for high-power industrial applications of direct current.

Prototype model will supply 1200 amp continuously, 1500 amp for two hours or 2100 amp for 10 seconds. Circuit is 6-phase, 2-way. Output is 250 volts.

After the experimental unit racks up some satisfactory experience, commercial uses of this type of rectifier will be determined by development of suitable scr devices. With present rapid development of scr cells, economically feasible devices should become available within the next few years, Westinghouse rectifier experts predict.

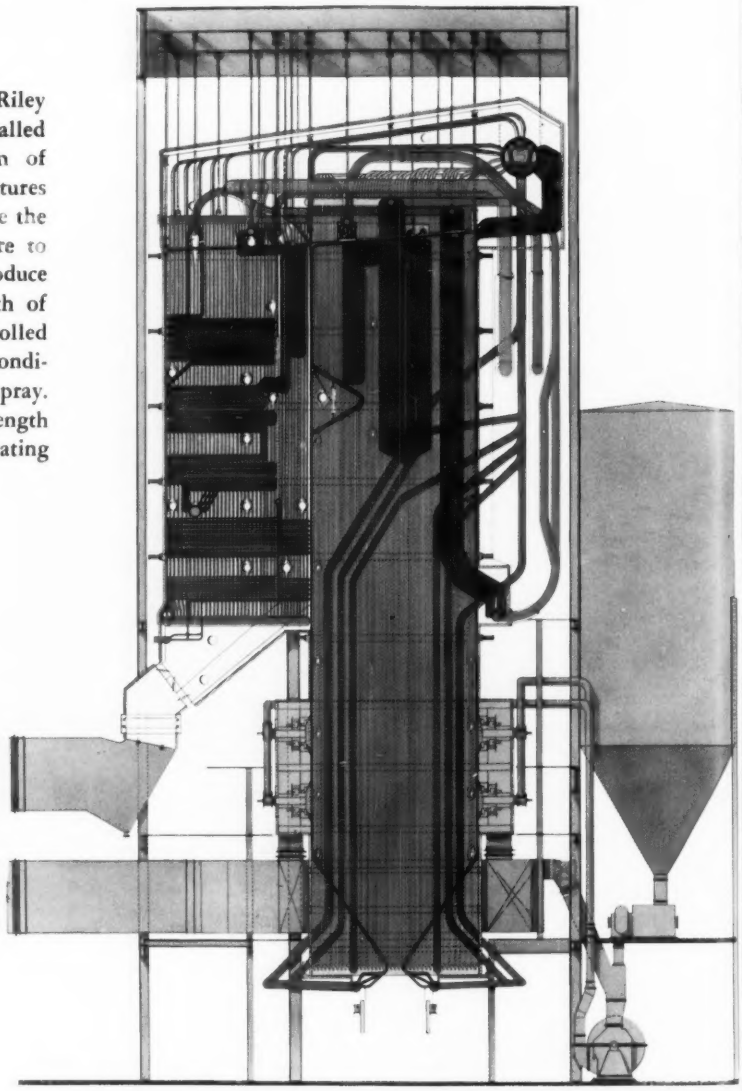
These two experimental units—inverter and rectifier—give evidence that the silicon-controlled rectifier is growing up to where it will soon tackle big jobs.

COMPLETE RILEY BOILER

for GOLDSBORO STEAM ELECTRIC STATION CAROLINA POWER & LIGHT COMPANY

The high pressure natural circulation Riley reheat steam generating unit soon to be installed at the Goldsboro Steam Electric Station of Carolina Power & Light Company features radiant superheater platens which will have the effect of reducing furnace gas temperature to correct levels at exit and also will produce uniform temperature across the full width of the furnace. Reheater temperature is controlled by dampers without spray under normal conditions. Steam temperature is controlled by spray. Large downcomers spaced equally across length of drum provide uniform feed to generating tubes.

EBASCO SERVICES, INC.
Consulting Engineers



RILEY COAL FIRED BOILER for

GOLDSBORO STEAM ELECTRIC PLANT
Unit No. 3
CAROLINA POWER & LIGHT COMPANY

- Capacity ..... 1,620,000 lbs/hr
- Operating Drum Pressure ..... 2640 psig
- Superheat/Reheat ..... 1005/1005 F.
- Fired by Coal
- 5-550 Riley Pulverizers
- 20 — Riley Burners Arranged for Opposed Firing in Single Furnace — 58 feet wide.

A careful survey of your plant by a qualified consulting engineer could show ways of making substantial savings in power costs.

RILEY

STEAM GENERATING & FUEL BURNING EQUIPMENT

RILEY STOKER CORPORATION, WORCESTER, MASSACHUSETTS

Sales Offices: Boston, Charlotte, Chicago, Cincinnati, Cleveland, Denver, Detroit, Honolulu, Houston, Jacksonville, Kansas City, Los Angeles, New Orleans, New York, Philadelphia, Pittsburgh, Portland, Salt Lake City, San Francisco, St. Louis, St. Paul, Seattle, Syracuse.

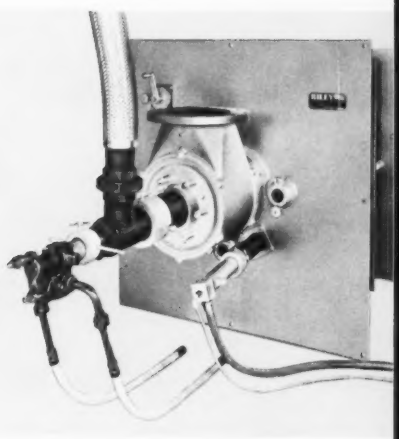
features

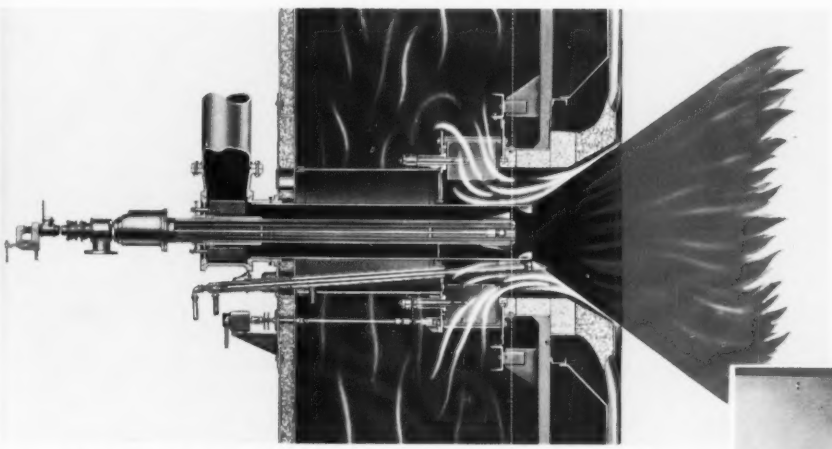
- 2640 P.S.I. OPERATING PRESSURE
- PLATEN TYPE RADIANT SUPERHEATER
- NEW TYPE 60 FLARE TYPE BURNER
- OPPOSED WALL FIRING
- NEW TYPE 60 DUPLEX PULVERIZERS

NEW RILEY BURNER HAS SIMPLIFIED FRONT PLATE — IDEAL FOR AUTOMATIC OPERATION

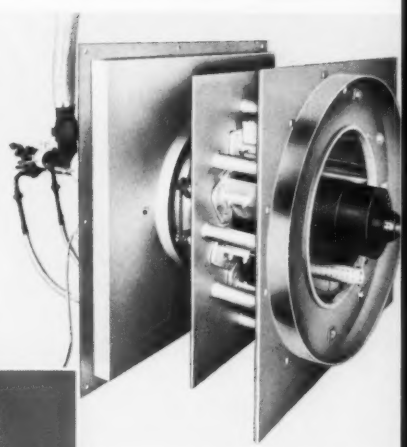
Some Operating Advantages:

- Mechanical moving parts move with boiler expansion—will not bind or jam.
- Vane control mechanism does not require lubrication.
- Automation with remote secondary air vane adjustment and indicators.
- Idle burners and ignitors well protected.
- Smooth, stable non pulsating flame thru load range.
- Non-plugging coal nozzle design.
- Turbulent mixing of primary air-coal secondary air.
- 180° rotation of vanes.

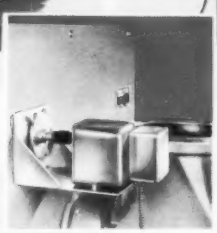




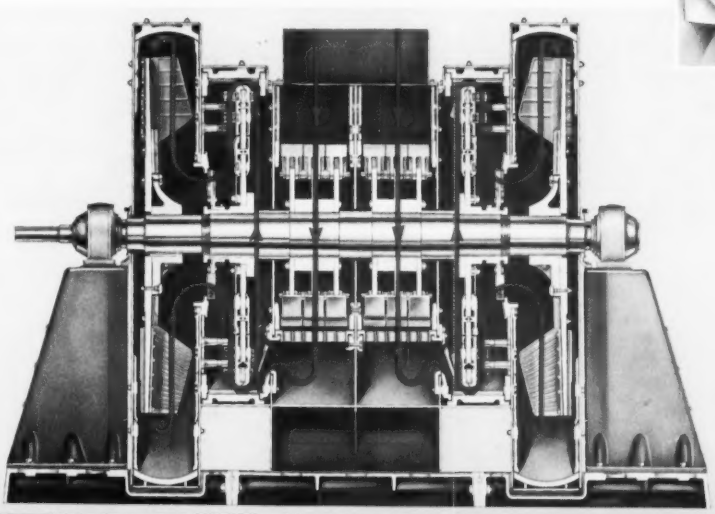
Arrangement for coal, oil, gas with pressurized boiler operation.



Above — Burner assembly for water-cooled burner throat.



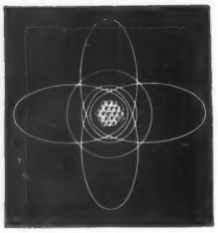
Power unit for automated operation



NEW TYPE 60 DUPLEX PULVERIZER — has single coal entrance—two exits. New arrangement reduces number of feeders required. Simplifies automatic control of supply of coal and primary air.

Other features: minimum space requirements, quiet operation, sustained high fineness, tungsten carbide faced pulverizing elements, flash dries wet coal.

RILEY STOKER CORPORATION
WORCESTER, MASSACHUSETTS



Nuclear notes

By B G A SKROTZKI, Associate Editor

Spectral Shift Control Reactor (SSCR) will use varying mixture of light and heavy water as coolant, moderator and partial control agent. Varying the concentration of two kinds of water as moderator compensates for reactivity changes by taking advantage of neutron energy changes (spectral shift) as the fuel burns up and builds up poisons. High concentrations of D_2O will be used at the start of core life to hold down the fissions caused by thermal neutrons, allowing epithermal neutrons to cause fissions and be absorbed in fertile material. As the reactor burns fuel, increasing the proportion of light water would allow more fissions by thermal neutrons to make up the reactivity loss. Babcock and Wilcox Company is carrying on this work for the AEC. AEC intends to amend B&W's facility license to authorize doing the experimental work at the Critical Experiment Laboratory in Lynchburg, Va. Major advantages of the SSCR: longer fuel lifetime, lower fuel costs, more uniform power distribution, better neutron economy, greater production of fissionable material and minimum control-rod needs.

Brazil's National Nuclear Energy Commission is planning a second power reactor to be installed in either the semi-arid northeast "bulge" or in the Amazon River Valley. First reactor, a 150-to-200-mwe plant scheduled for a 1965 start, will be installed on the Mambucaba River between Rio and São Paulo. (*McGraw-Hill World News*)

Nuclear meeting of the American Nuclear Society, and the Atomic Industrial Forum together with an AtomFair is expected to attract 10,000 visitors. Meeting will be held in the Conrad Hilton Hotel, Chicago, Ill., Nov 6-9, 1961.

"Industrial Applications of Radioisotopes," a 16-mm color motion picture running for 57 minutes, may be bought or borrowed from the AEC. Film surveys the wide use industry makes of isotopes: thickness, density and level gaging, radiography and tracing. Specific applications are shown for rubber products, sheet metal, plastics, paper, nylon, food and containers, shipbuilding, oil and automobiles. Potential uses include luminescence, static elimination, isotopic power and high-intensity radiation. Animated sequences explaining the basic principles of radioisotopes are followed by concrete examples of applications. The film may be borrowed from any of the AEC's ten domestic film libraries, or U.S. embassies in London, Brussels, Buenos Aires and Tokyo.

Record melt of technetium has been made by the Oak Ridge National Laboratory. The button weighs five grams (1/90 lb) and was made by arc melting; the metal is soft and ductile. Technetium-99, element No. 43, no longer exists in the earth except as a minute trace. It gives off beta rays and decays to stable ruthenium-99 with a half-life of 210,000 years. The material has been recovered from spent reactor fuel elements, lowering its price from $2800 to about $100 per gram. The pertechnetate ion derived from technetium is an extremely strong corrosion inhibitor for iron and steel.

AEC booklet, "Nuclear Reactors Built, Building or Planned in the U.S. as of December 31, 1960", is now available without charge from the Office of Technical Information Extension, U.S. AEC, Box 62, Oak Ridge, Tenn. The 26-p book lists civilian reactors (domestic), military reactors, production reactors, reactors for export and critical assembly facilities with their locations and principal statistics.

BOILERS TO GO!

Delivered to the installation site by rail, truck or boat, shop-assembled Vogt Package Water Tube Boilers can be quickly placed in operation. After being placed from the carrier onto a simple low-cost concrete slab, a Vogt unit requires only piping, electrical and stack connections to go to work.

Little space is required because of their compact design and integrated firing equipment and controls.

A pressure type steel casing permits outdoor operation, if desired, eliminating the need for an expensive building.

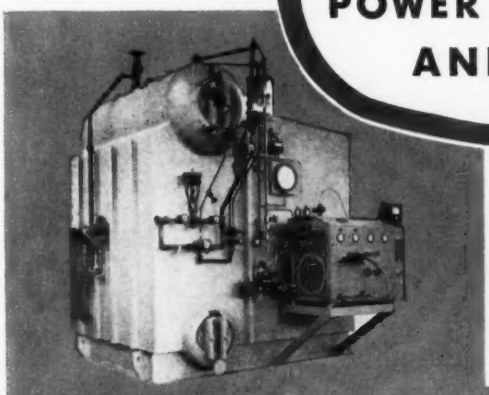
Write for literature. Address Dept. 24A-BP

Vogt

PACKAGED BOILERS

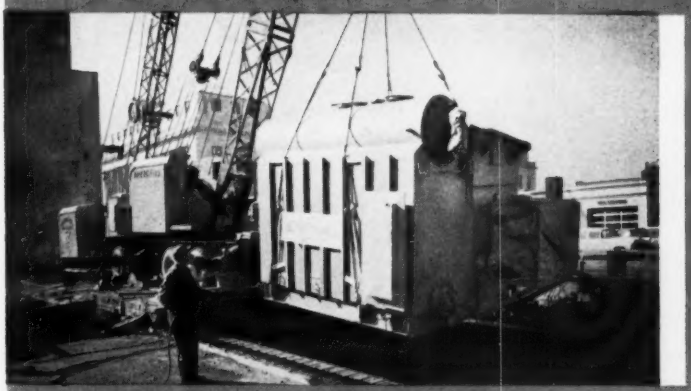
Shop Assembled for

POWER • PROCESSING AND HEATING

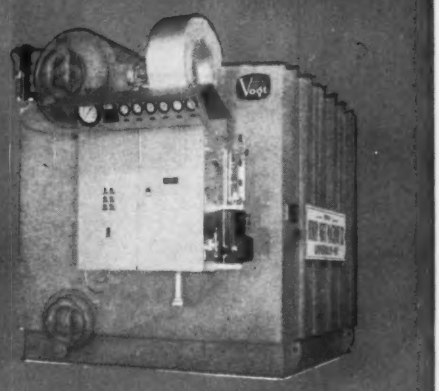


BOX PLANT — A 10,000 pounds/hour unit

HOSPITAL — Two 30,000 pounds/hour units



PRINTING PLANT — Two 20,000 pounds/hour units



OIL COMPANY — A 15,000 pounds/hour unit

For Direct Long Distance to Louisville dial: 502 ME 4-9411

Package Unit Bulletin PSG-3 available on request

HENRY VOGT MACHINE CO.

P.O. BOX 1918, LOUISVILLE 1, KENTUCKY

SALES OFFICES: Camden, N. J., Charleston, W. Va., Chicago, Cleveland, Dallas, Los Angeles, New York, St. Louis.

For more facts circle 250 on Reader Service card, p 103

Compare compressor power and capacity needs

	Evaporating temperature, F						
	0	10	20	30	40	50	60
Refrigerant	Cfm per ton						
R-11	45.5	35.4	25.6	20.7	16.3	13.1	10.7
R-12	7.1	5.8	4.7	3.9	3.1	2.7	2.2
R-22	4.4	3.6	3.0	2.4	1.94	1.65	1.45
R-114	24.8	18.8	15.6	11.5	9.25	7.25	5.73
NH_3	4.15	3.26	2.64	2.12	1.76	1.45	1.19
	Bhp per ton						
R-11	1.90	1.66	1.27	1.05	0.88	0.68	0.48
R-12	2.00	1.67	1.26	1.09	0.94	0.72	0.45
R-22	1.96	1.71	1.47	1.29	1.00	0.78	0.58
R-114	2.34	2.10	1.73	1.68	1.33	0.94	0.71
NH_3	1.89	1.60	1.37	1.14	0.97	0.79	0.59

This chart is useful in planning new refrigeration or air-conditioning installations and selecting most economical refrigerant to use. Capital cost of a refrigeration system or air-conditioning component is a function of the size of machinery required for compression. Cost of operating a refrigeration or air-conditioning system is a function of the power required to drive the components.

Table, left, lists comparative compressor-capacity and power-requirement figures for various evaporating temperatures. By balancing capital cost against operating cost for various refrigerants you can select your optimum system.

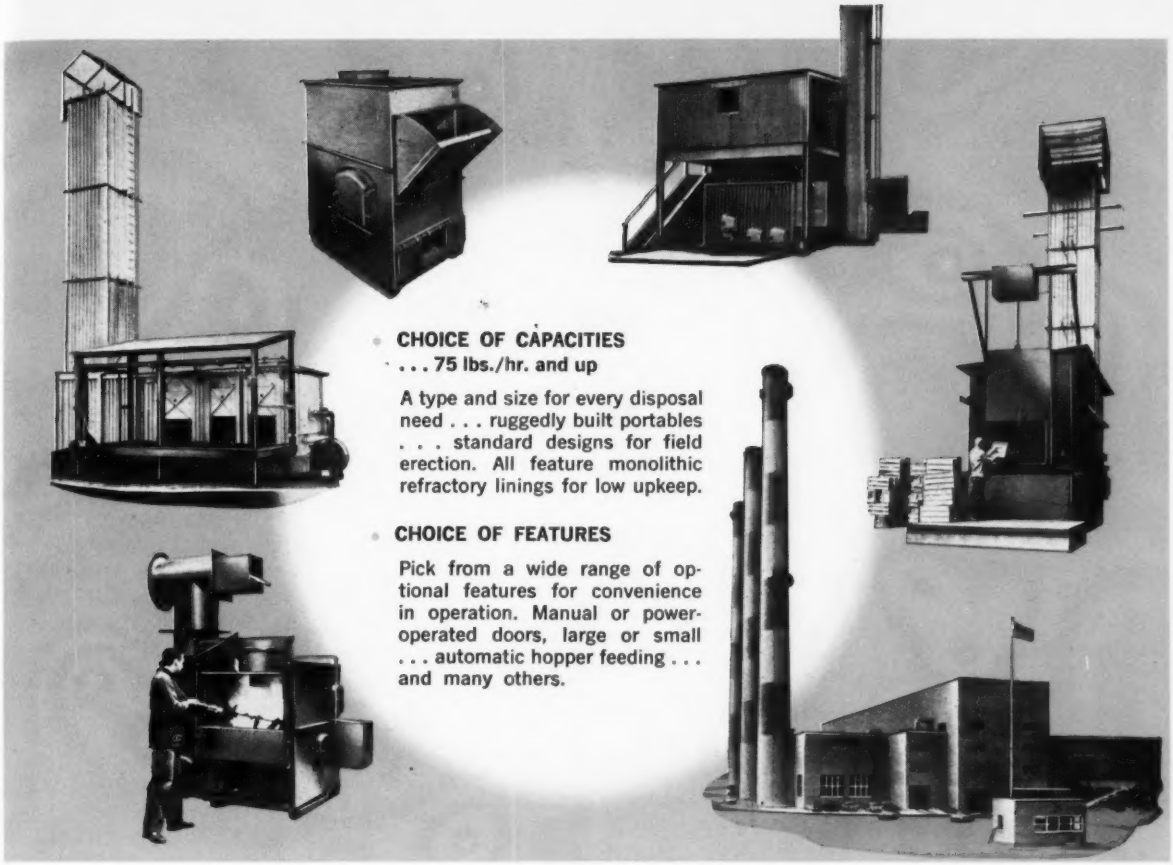
Data is based on these assumptions: condensing temperature, 100 F; overall compression efficiency, 70%; superheat at compressor inlet, 10 F.

Example: For a 100-ton refrigerating system with 30-F evaporating temperature, maximum compressor pumping capacity would be required by R-11—100 x 20.7 = 2070 cfm. Minimum capacity would be required by ammonia—100 x 2.12 = 212 cfm. Power requirements would range from 105 hp for R-11 to 114 hp for ammonia.

H DePaoli, *Emmaus, Pa.*

R-11 is CCl_3F	Trichloromonofluoromethane	(Freon-11)
R-12 is CCl_2F_2	Dichlorodifluoromethane	(Freon-12)
R-22 is $CHClF_2$	Monochlorodifluoromethane	(Freon-22)
R-114 is $C_2Cl_2F_4$	Dichlorotetrafluoroethane	(Freon-114)
NH_3	Ammonia	

© POWER



CHOICE OF CAPACITIES
. . . 75 lbs./hr. and up

A type and size for every disposal need . . . ruggedly built portables . . . standard designs for field erection. All feature monolithic refractory linings for low upkeep.

CHOICE OF FEATURES

Pick from a wide range of optional features for convenience in operation. Manual or power-operated doors, large or small . . . automatic hopper feeding . . . and many others.

Choose a Plibrico Incinerator . . .

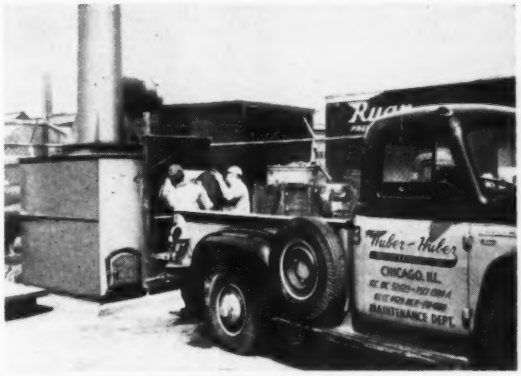
CUT YOUR HAULING COSTS

Here's a typical example . . .

Huber and Huber,
Interstate Carriers, Cut Their Costs by 80%!

William J. Huber, operations manager of Huber and Huber reports: "A cost survey showed we were paying $100 to $120 a month to have burnable refuse hauled away from our terminal. After installation of our Plibrico incinerator, we ran another cost check and found that present scavenger service is down to $20 per month".

If you're paying to have refuse hauled away, you'll profit by investigating the advantages of a Plibrico incinerator for on-the-spot burning. Besides lower hauling costs, you will benefit from improved sanitary conditions, more usable space, and reduced fire hazards.



NOW YOU CAN LEASE THE PLIBRICO INCINERATOR OF YOUR CHOICE.
Use it; enjoy all its advantages without capital investment.

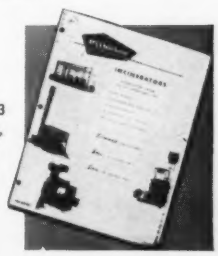
REFRACTORIES
INCINERATORS
ENGINEERING
CONSTRUCTION
Plibrico

PLIBRICO COMPANY

1823 North Kingsbury Street, Chicago 14, Illinois
Canadian Plant: New Toronto, Ontario
Sales and Service Throughout the World

1203

FREE CATALOG 63 gives applications, engineering data and capacities.



For more facts circle 251 on Reader Service card, p 103

Exide determines the best battery type and charger for you by studying your particular duty requirements

Selecting a battery and charger today is really an engineering job. Each application has its own requirements. That's why Exide offers a variety of batteries and chargers—in fact the broadest in the field. It means you can buy the type battery and charger you should have. Because Exide has no ax to grind for any particular type, you can expect an unbiased recommendation.

The battery line includes (1) flat plate Tytex with Silvium;* (2) flat plate Tytex with calcium; (3) long-life Exide-Manchex—Planté type—with Silvium; (4) low-maintenance pocket positive nickel-cadmium; (5) new 20-year Exide-Ironclad tubular with Silvium. The charger line includes (1) constant voltage type; (2) trickle or Hi-Lo type. You get Exide quality and value on all.

An Exide power package lets you buy with confidence. Exide service—the quickest, most dependable you can get—covers battery and charger. For complete information, write Exide Industrial Marketing Division, The Electric Storage Battery Company, Philadelphia 20, Pa.

*Silvium is Exide's patented corrosion-resistant grid alloy

Exide®

INDUSTRIAL MARKETING DIVISION (ESB)
The Electric Storage Battery Company

For more facts circle 252 on Reader Service card, p 103

Every 7 seconds . . .

Lapsed time between OIC installations is being reduced month by month. More and more maintenance men know they can count on trouble-free operation when they replace worn out valves with OIC. Performance-proven design features include stems made from special OIC Alloy 40 on bronze valves. Result . . . seizing completely eliminated . . . corrosion minimized . . . wear greatly reduced. OIC stems will outlast ordinary valve stems 10 to 20 times. Your local OIC distributor carries a complete line of bronze and iron gates, globes, angles and checks. Call or write today for further information.

BETTER VALVES AND BETTER DISTRIBUTOR SERVICE FROM OIC

someone . . .
somewhere . . .
installs
another
OIC valve!

OIC VALVES

BRONZE, IRON, FORGED STEEL, CAST STEEL AND DUCTILE IRON VALVES

INDUSTRIAL DISTRIBUTORS SERVING INDUSTRY ECONOMICALLY THE RIGHT HAND OF PRODUCTION

THE OHIO INJECTOR COMPANY, WADSWORTH, OHIO

THE OHIO INJECTOR COMPANY 10231-OIC
251 Main St., Wadsworth, Ohio
I need more information about OIC bronze and iron valves.
Name_____
Company_____
Street_____
City_____ Zone_____ State_____

For more facts circle 253 on Reader Service card, p 103

Technical briefs . . . A world-wide look at

To find out how to get more information on any of these papers, see box on p 100

American Power Conference covers many fronts—new cycles, automatic control and nuclear power

Improvement in economics of a 678.5-mw combined cycle plant over a 678.5-mw conventional steam cycle plant, *H J Peterson, United Engineers & Constructors Inc, and J O Stephens, Westinghouse Electric Corporation*
For study purposes, a detailed comparison was made between two units with identical output capacity. Conventional steam cycle was a 2400-psig 1000/1000-F unit with seven stages of heating. Combined cycle used gas-turbine exhaust for furnace air. Steam-cycle output was reduced by amount equal to gas-turbine-driven-generator output after allowing for changes in auxiliary loads.

Conventional-cycle heat rate was 8962 Btu per kwhr vs 8666 Btu per kwhr for the combined cycle. The 3.3% heat-rate gain was principally due to total energy extracted from the furnace gas—1150-F differential in the combined cycle vs 900 in the conventional cycle.

Installed costs were practically identical but energy-cost differences were significant—5.977 mills per kwhr for the combined cycle vs 6.095 for the conventional cycle. This reflects an annual operating-cost saving of $588,000 for the combined cycle. *APC*

Binary cycle for power generation, *David Aronson, Worthington Corporation*
This new cycle is based on a supercritical-steam system rejecting its heat to a low-temperature dichlorodifluoromethane cycle. Its unique characteristics lead to consideration where low ambient temperatures prevail, cooling water is scarce or unavailable or physical size of units results in a multiplicity of exhaust ends with steam as the sole working fluid. About 80% of the total power would be produced in the steam cycle, 20% in the l-p cycle.

Only water-cooled cycles are discussed, but air-cooled condensers of the air-conditioning type would eliminate the risk of freezing.

Characteristics of l-p working fluid are discussed, together with details of equipment in this part of the cycle. Cost and heat-rate comparisons show cycle advantages. *APC*

Automation of system operation, *H J Fiedler and L K Kirchmayer, General Electric Company*
Overall electrical-system automation is reviewed in detail. Operations-planning area includes load forecasting, maintenance scheduling, fuel selection and evaluation of possible interconnection transactions.

Operations control breaks down into a consideration of distribution-system and generating-plant problems. Latter include startup and shutdown, off-limit supervision and alarm and continuous control of complete boiler-turbine-generator unit.

Finally, operations accounting covers billing, production statistics and quality assessment of unit and system performance.

Equipment and performance details in these operational areas complete the picture. *APC*

Monitoring, logging and computing performance for an existing coal- and oil-fired station, *M J Feldmann and J W Purssell, Boston Edison Co*
To date, most automatically monitored stations have been new, but Boston Edison is now installing automatic monitoring, logging and performance computing in their existing Mystic Station. Mystic is made up of six generating units, three of 50 mw, two of 125 mw and one of 137.5 mw. Largest units are 1800 psig, 1000/1000 F.

Total cost of installed automatic controls: $941,300, amortized over a 10-year period which results in a 22% carrying charge. Net operational savings are estimated at $214,700—a 22.8% return per year. And, of course, anticipated unit life extends well beyond the 10-year amortization period.

System provides (1) computer information system (2) annunciation (3) indicating instrumentation (4) television and (5) plant communication system. These are centralized in an information room between units 4 and 5. Functions performed: (1) automatically log 264 items of turbine and boiler operating data (2) scan 436 bearing and process measurements at a rate of five points per second with automatic alarm and record of off-normal data (3) compute boiler efficiencies, net heat rates (within ½%) (4) on demand, trend print during each scan cycle any measured or calculated value and (5) on demand, print out on the off-normal strip printer (or display on the console) any measured, calculated or stored value.

Details of system are given, including security, emergency power and field expandability. *APC*

An integrated turbine-reactor control system for the sodium-reactor experiment, *R J Hall, Atomics International and F C Six, Leeds and Northrup Company*
As large nuclear-power plants gain in percent of total generation, controls must develop to permit

their operation in parallel with existing fossil-fueled generating stations. Control system described meets this need and permits rapid change in thermal-power level—20% per minute.

Thus sodium-cooled reactor follows load demand during rapid load changes without adversely affecting heat-transfer characteristics or stability of the reactor complex. System uses commercially available, proved components.

Control system and components are detailed. They are capable of four modes of operation: (1) manual (2) manual reactor with automatic turbine following (3) automatic load following for once-through steam generator (4) automatic load following for drum type boilers. *APC*

Federal versus state regulation in the development of atomic power, *G E Drach, Illinois State Senator*

Part of the present controversy regarding regulation of atomic power—Federal vs state—is based in the way this science developed. Past developments in other areas, such as steam, electricity, the airplane, originated in private hands, were patented and later became subjects of law and statute and then of military utilization. Development of nuclear energy was precisely the reverse process; it was first developed for military utilization by the Federal government.

A 1959 amendment to the Federal Atomic Energy Act permitted greater participation by the states. It authorized AEC to contract with them to discontinue federal regulatory authority in certain areas. Current proposed amendment further implements this contractual agreement between the Federal government and the states.

It is felt, however, that a contractual method of dividing regulatory authority is neither practical nor workable. Rather, the Federal government should set up the areas of nuclear energy it must regulate, leaving the states to legislate for the protection of public health and safety on all facets of nuclear energy over which the Federal government has no need for control. *APC*

Gas turbines

The coal-burning closed-cycle gas turbine, *C Keller and W Gaehler, Escher Wyss Ltd, Switzerland*

European experience in coal-burning gas-turbine cycles over the past ten years is detailed. A 2300-kw plant at Ravensburg, Germany started up in 1956, has accumulated over 24,650 hr of industrial service. This plant provides waste heat for hot-water space heating as well as electric power. Design basis was a 500-kw unit in Scotland started up in 1951.

Equipment design is detailed, stressing heaters. Authors state that in Europe (and as far as they know in the U.S.) economic gas-heater design is prevented by application of boiler-code practice. They feel that applying requirements from an old field limits progress. *ASME 61-GTP-2*

Practical realization of gas turbines combined with steam and industrial heat cycles, *W P Auer, Brown Boveri Corp*

Combined steam-gas turbines of two basic types installed in Europe now have enough operating time to prove theoretical efficiency gains. One type involves building the steam generator right into the gas-turbine cycle where it is arranged ahead of the turbine and works as a pressurized boiler. This is likely to be the most favorable of all combined cycles and may bring considerable improvement, even over the most advanced steam plants.

Second cycle recovers exhaust heat of the gas turbine in a steam plant. Only a few of these plants have been built, probably from fear of reduced availability due to operating difficulties.

Several combined cycles in Europe are described in detail, including a peaking central station in Vienna, two captive steel-mill plants and a heating plant in Germany. For one of the steel-mill plants, inspection findings after 62,000-hr operation are detailed. *ASME 61-GTP-11*

Standby power for Hydro-Quebec uses gas turbines, *H W Haberl, Quebec Hydro-Electric Commission and D F Abel, Canadian General Electric Company*

Electric power for the Gaspé Peninsula is provided by Quebec Hydro-Electric Commission through 69-kv cables crossing the St. Lawrence River at a point 32-mi wide. Cable operation has been satisfactory for years, but some form of standby power on the south side of the St. Lawrence was needed.

Design, construction and initial operation of six 6450-kw gas-turbine generators is detailed. Standby plant, located adjacent to existing substation at Les Boules, is completely self-sustaining. Special provision for fuel-oil heating was made necessary by possibility of extremely low startup temperatures. Should underwater cable fail, no power would be available for turbine startup motors, so an auxiliary diesel-generating set has capacity to start any one g-t startup motor through the auxiliary bus.

Construction time: 8½ months from appropriation to full station output. *ASME 61-GTP-4*

(Advertisement)

Control of thermal expansion in piping

Flexible support can prevent destructive stresses in high temperature piping

Heat 100 linear feet of alloy steel pipe to 1000°F, and it will expand approximately 9 inches! When this thermal expansion takes place in a piping system, the resultant forces — if uncontrolled — can do incalculable harm.

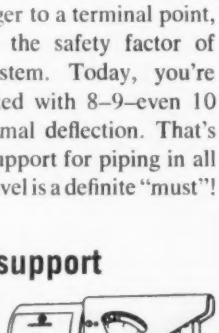
Helical coil springs

Using helical coil springs to compensate for thermal expansion in piping is now common practice. However, designing or selecting flexible supports is often done haphazardly. In fact, any specifications covering the support of important high temperature piping simply say "spring hangers shall be provided." But it is not enough to merely admit that thermal expansion may be dangerous.

Safety of entire system at stake

Careful study must be given to the design and selection of spring supports which will maintain a balanced piping system. If not, the transfer of weight from one hanger to another, or from a hanger to a terminal point, will endanger the safety factor of the entire system. Today, you're often confronted with 8–9–even 10 inches of thermal deflection. That's why flexible support for piping in all positions of travel is a definite "must"!

Constant-support hangers

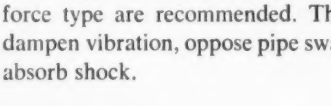


Where reactive forces at terminal points in a piping system must be kept within specified limits, Grinnell constant-support type hangers are recommended. They are designed to provide uniform supporting force equal to the pipe load throughout the range of thermal movement. Constant-support hangers should be used at superheater outlets, turbine connections, and on high temperature and other critical lines.

Variable spring hangers

When pipe lines are subject to vertical movement — and restrictive conditions do not require a constant-support hanger — variable spring hangers are recommended. They should be designed for a maximum variation in supporting effect of 25% for the total travel resulting from thermal conditions.

Vibration control and sway braces

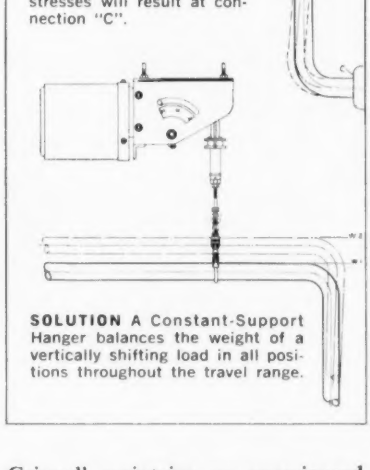


When you have to prevent abnormal movement or vibration in pipe lines, controls or sway braces of the energy-absorbing and instant-acting counter force type are recommended. They dampen vibration, oppose pipe sway, absorb shock.

Grinnell Hanger Engineering Service

Grinnell Company's Pipe Hanger Department offers design service to engineers who appreciate the specialized knowledge required. Grinnell will help you compute hanger loads . . . and select proper supports for a *balanced* pipe suspension system.

What's more, Grinnell manufactures a complete line of pipe hangers and supports — and offers stocks of pipe hangers close to any job!

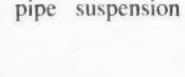


PROBLEM If Pipe Hanger "H" does not support full weight of piping "W" in both cold position "1" and hot position "2", dangerous stresses will result at connection "C".

SOLUTION A Constant-Support Hanger balances the weight of a vertically shifting load in all positions throughout the travel range.

Grinnell maintains an experienced staff of technicians to discover better ways of solving pipe suspension problems, too.

Hanger load calculation booklet



Grinnell will be glad to send you — without obligation — a 32-page booklet, "Calculations for Hanger Loads and Thermal Movements". This helpful booklet furnishes necessary data and procedures to determine pipe hanger loads and thermal movements. Tabulations of piping weights and thermal expansion are arranged for convenient selection of data that usually takes considerable time to develop. Send for your copy *today*. Grinnell Company, Providence 1, R. I. Branch Warehouses in Principal Cities.

For more facts circle 254 on Reader Service card, p 103

Technical briefs

Begins on page 92

Safety

Safety aspects of emergency power systems, *C F Willett and E J Dubois, Automatic Switch Co*
Emergency lighting methods depend on building end use. Hospitals top the list since absolutely no power outage can be tolerated—operating procedures cannot be interrupted even for a few seconds. Schools, public buildings and utilities, while below hospitals in need, still base minimum requirements on public safety. Vital industrial processes that are expensive to interrupt justify their own emergency power systems.

Reliability of the emergency system is first consideration in design. Period of idleness must not affect its prompt functioning.

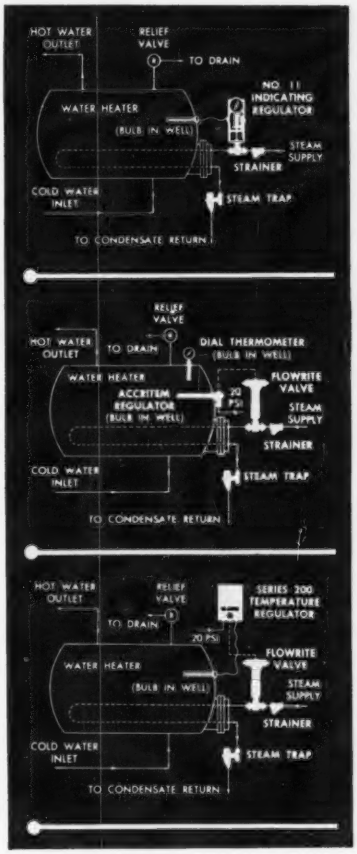
Emergency lighting systems can operate from one of several sources: unit storage batteries, central battery systems, engine-generator sets or additional utility main feeders. Economics and local conditions dictate choice—each has advantages and disadvantages. Unit storage batteries, for instance, may be best where areas are small or widely separated, but such systems need frequent testing. *AIEE CP 61-41*

Recent progress in safety and service continuity in molded-case circuit breakers and enclosed switches, *J E Bayles and R R McGee, General Electric Company*
Maximum safety and service continuity of industrial and commercial power systems require complete knowledge of application conditions, intelligent selection of circuit protective devices. These include load current, circuit voltage, frequency, duty cycle, environmental conditions, available short-circuit current and personnel safety.

Molded-case breakers now available include units with ratings to 1000 amp, 600-v ac and interrupting ratings to 65,000-amp symmetrical (75,000-amp asymmetrical) at 240 v; 35,000-amp symmetrical (40,000-amp asymmetrical) at 480 v and 25,000 amp symmetrical (30,000-amp asymmetrical) at 600-v ac.

Molded-case breakers have been tested with current-limiting fuses and

Practical Ways To Control Hot Water Storage Heaters



THE POWERS REGULATOR COMPANY
Dept. 561, Skokie 24, Illinois

Send me a free copy of Powers Engineer's Manual For Steam-Water Service

Name:_____

Title:_____

Company:_____

Address:_____

City:_____ Zone:____ State:_____

Specific requirement or problem:

These diagrams, plus clear and concise information on storage heater control, are available to you without obligation as part of the Powers *Engineer's Manual, Steam-Water Service.*

This manual has been specially prepared for plant use. It is available free to personnel whose job function covers operation and/or installation of steam-water service. Various control systems described and illustrated include: domestic hot water . . . instantaneous heat exchangers . . . heat exchangers for cooling . . . fuel oil heaters . . . pressure reducing . . . jacket water cooling . . . two-temperature hot water systems.

Send for your Engineer's Manual now! If you have a special requirement or problem ask for recommendations.

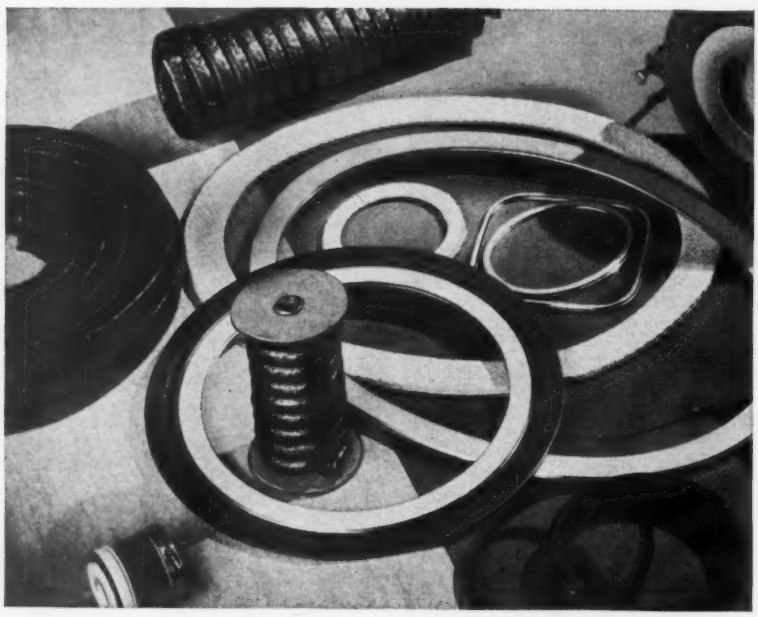
POWERS CONTROL

THE POWERS REGULATOR COMPANY
Dept. 561, Skokie 24, Illinois
In Canada: The Powers Regulator Co. of Canada Ltd. Downsview, Ontario

For more facts circle 255 on Reader Service card, p 103

SOLD THROUGH INDUSTRIAL DISTRIBUTORS

Find the Belmont Distributor nearest you in Conover-Mast Purchasing Directory or Thomas' Register Packing Sections



THE MOST COMPLETE LINE OF MECHANICAL PACKINGS *

Dependable Local Service • Always Available • Prompt Delivery

*HIGH PRESSURE ASBESTOS • ROTARY PUMP PACKINGS • VALVE PACKINGS • V-RINGS • LEATHER PACKINGS • SHEET PACKINGS AND GASKETS • HYDRAULIC & PNEUMATIC PACKINGS • METALLIC PACKINGS • PLASTIC PACKINGS • TEFLON PACKINGS & GASKETS • SPIRAL WOUND GASKETS

Better Buy **BELMONT**

THE BELMONT PACKING & RUBBER COMPANY • PHILADELPHIA 37, PA.

Technical briefs

Begins on page 92

application parameters established for available short-circuit currents to 100,000-amp symmetrical. Enclosed safety switches and disconnects have been tested with current-limiting fuses for application on circuits with up to 200,000-amp symmetrical available on short circuit. *AIEE 61-156*

Nuclear developments

Office of Technical Services, U.S. Department of Commerce *have papers interesting to energy-systems engineers:*

40-mwe prototype high-temperature gas-cooled-reactor research and development program (*GA-1235*), Sept 1960, 185 pp, $3.00

Design study of sodium modular reactor (*GEAP-3334*), Jan 1960, 388 pp, $5.00

Nuclear-superheat-project second quarterly progress report for Oct-Dec 1959 (*GEAP-3371*), Sept 1960, 178 pp, $2.75

Quarterly status report of the LASL plasma-thermocouple-development program for period ending Sept 20, 1960 *(LAMS-2473)*, Oct 1960, 16 pp, 50¢

Liquid fluidized-bed reactor experiment: final report—TASK 4.00 (*MND-LFBR-2337*), 136 pp, $2.75

Thermophysical properties of irradiated polyphenyl coolants: Part II—density and viscosity *(NAA-SR-4484)*, Dec 1960, 56 pp, $1.25

An evaluation of fossil superheat for nuclear-power plants *(NYO-9400)*, Oct 1960, 297 pp, $3.50

Gas-cooled-reactor project quarterly progress report for period ending Sept 30, 1960 (*ORNL-3015*), 174 pp, $2.75

Bettis Technical review: Reactor technology *(WAPD-BT-20)*, Sept 1960, 131 pp, $2.50

Technical progress report: Pressurized-water reactor (pwr) project for the period Aug 24, 1960 to Oct 23, 1960 (*WAPD-MRP-88*), 97 pp, $2.25

Fabrication of Yankee core I prototype fuel element (*YAEC-144*), May 1960, 52 pp, $1.25

Emissivity and emittance—what are they? (*PB-161-222*), by

This 25' Ljungstrom rotor will contain a total heating surface of 128,000 sq ft. Continuous heat recovery by this unit will boost the temperature of incoming combustion air from 100°F to 585°F. Every 45-50°F thus returned as preheat increases boiler efficiency about 1%.

DOW RECOVERS 425°F WITH LJUNGSTROM® AIR PREHEATER

When Dow Chemical Company's Westside Power House at Midland, Mich., starts up their new 650,000 lb/hr boiler, more than half the waste heat will be *recovered* by a Ljungstrom Air Preheater. Dow's newest Ljungstrom (this is the eighth in their system) was designed to lower stack gas temperature from 700°F to 275°F, thus *recovering 425°F.* As a direct result, company engineers expect at least 10% reduction in fuel costs.

On process stills or boilers—or wherever large volumes of heat are involved—Ljungstrom Air Preheaters improve combustion, make fuel burn more completely. It's possible to save as much as 20% on fuel. ***All* major public utilities** use Ljungstroms; as do many major chemical and petroleum processing companies. Chances are, you, too, could benefit. For additional information, call or write The Air Preheater Corporation, specifying type of application.

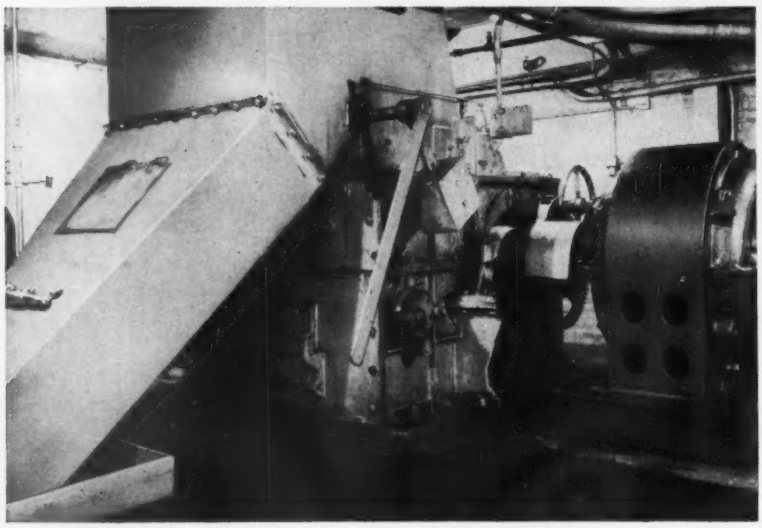
THE AIR PREHEATER CORPORATION

60 East 42nd Street, New York 17, N.Y.

For more facts circle 257 on Reader Service card, p 103

CRUSHING FACTS

from *American* PULVERIZER CO.



USER REPORT **"7,000,000 TONS OF COAL**

reduced to 3/4" by this crusher, and it is still going strong"

After 23 years of operation, this American AC Rolling Ring Coal Crusher is still giving excellent service.

Replacement parts, plus standby parts, for reducing 7,000,000 tons of coal have cost less than 1/5 of a cent per ton. **Quality is proven only by performance.**

There are solid engineering reasons for this performance. The crushing elements, composed of American-originated rolling shredder rings, split coal instead of crushing it. This means less wear on screens and liners, less attrition in the crushing chamber. The rings are manganese steel and are reversible to give double wear. Liners are easily replaced.

The entire rotor assembly and bearings are so carefully machined, aligned and balanced that a nickel will stand on edge when the crusher is operating!

You can depend on performance like this when you use an American Coal Crusher. Our engineers will advise you on the correct model for your reduction problem.

American PULVERIZER COMPANY

ORIGINATORS AND MANUFACTURERS OF RING CRUSHERS AND PULVERIZERS

1349 MACKLIND AVE. ST. LOUIS 10, MISSOURI

6008

For more facts circle 258 on Reader Service card, p 103

Technical briefs

Begins on page 92

Defense Metals Information Center, Battelle Memorial Institute, Nov 1960, 17 pp, 50¢. This is a short instruction course in the fundamentals of radiant-heat-transfer processes.

Standards

Standards laboratory series, *Bureau of Naval Weapons*

The Bureau of Naval Weapons has prepared a series of standards to insure greater scientific accuracy through more-uniform procedures and techniques in using laboratory instruments. First 23 of approximately 300 standards are now available, divided into three categories.

Instrument-calibration procedures: ac-dc voltage instruments, 10- to 1000-v full scale (PB 171 209); dc current instruments, 1.0- to 200-amp full scale (PB 171 210); decade resistors, 0.1- to 100,000-ohms per step—using L&N 4243-Al bridge (PB 171 211); dc voltage instruments, 15- to 1000-v full scale (PB 171 217); dc voltage instruments, 1- to 1500-mv full scale (PB 171 218).

Cross-check procedures: standard resistors, NBS type, 1 to 100,000 ohm—using L&N 4232-Al bridge (PB 171 200); standard inductors, 100 uh to 10 h, General Radio 1482 series—using GR 1632 A bridge (PB 171 201).

Measurement-system operation procedures: mass in air, 1 g to 30 kg, direct-weighing method (PB 171 202); force 0 to 60,000 lb, approximately, tension only (PB 171 203); voltage standing wave ratio, X band, 8.2 to 102.40 kmc, 1.01:1 to 10:1 (PB 171 204); dc resistance, 0.00001 to 1.0 ohm (PB 171 205); dc resistance, 0.1 ohm to 100 megohms (PB 171 206); dc resistance, 10 ohms to 1,000,000 megohms (PB 171 207); inductance, 1.0 uh to 10 h, direct method (PB 171 208); ac and dc voltage, 10 to 1000 v (PB 171 212); ac voltage, 0.0001 to 800 v, 60 cps (PB 171 213); dc voltage, 1.02 to 1000 v (PB 171 214); dc voltage, 0 to 1000 v (PB 171 215); frequency response, 10 cps to 10 mcps, 0.5 mv to 5.2 v and ac-voltage calibration dc to 10 mcps, 0.1 to 5.2 v (PB 171 216); capacitance, 0.1 to 1050 uuf, direct-

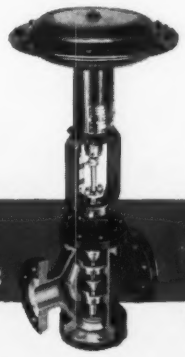
NEW DUCTILE IRON DIAPHRAGM CONTROL VALVES ARE TOUGH AS STEEL, BUT LOWER IN COST

K&M control valves made of ductile iron can save you a lot of price/performance juggling. Stronger than steel valves, harder than steel valves, they cost about 15% less. You can use them in processes where cast steel used to be an absolute must—applications calling for temperatures from −20°F to 650°F and pressures up to 1,000 psig.

Ductile iron, a metallurgist's pipe dream just a few years ago, makes castings that are as pressure tight as steel and as corrosion-resistant as gray iron. The castings have a better surface finish than steel and are easier to machine; inner contours are smoother, less subject to erosion. Ductile iron is strong enough (tensile strength—70,000 psi, yield strength—50,000 psi) and hard enough (160 Brinnell) that we even recommend its use in K&M split-body valves—formerly made only with steel bodies.

Ductile iron is available as a standard body material with all K&M valve series, and in all valve sizes. In addition, it is recommended as a topworks material for applications requiring high shock and vibration resistance. Both topworks and bodies are available in production quantities now . . . ready for dependable on-stream service for years to come.

Complete information is available either directly from K&M or from your local K&M sales representative.



K&M

diaphragm control valves

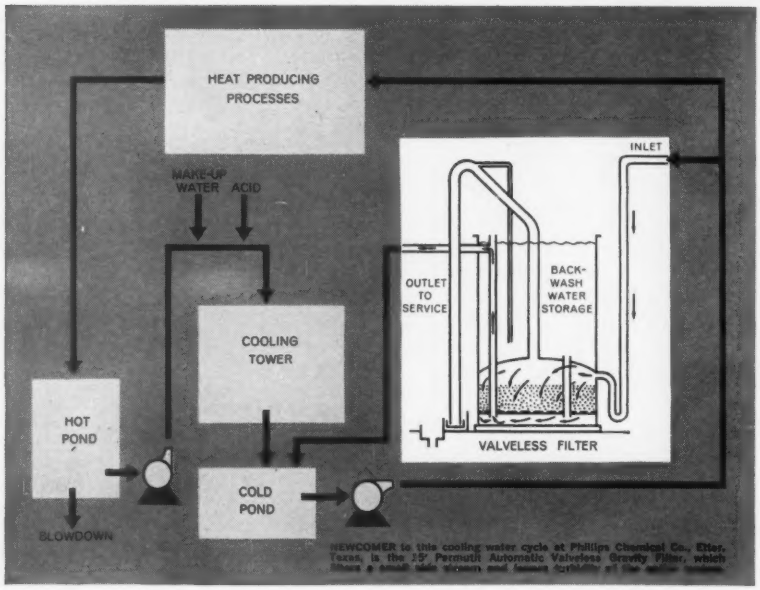
Our 80th Year

KIELEY & MUELLER, INCORPORATED

Oldest Pressure and Level Control Valve Manufacturer

64 Genung Street, Middletown, New York

FLUIDICS* AT WORK



New way to shrink yearly maintenance costs—improve heat exchanger operation

Here is a new wrinkle in cooling-tower operation:

Side stream filtration. It can appreciably cut your yearly bill for cleaning fouled heat exchanger surfaces and condenser tubes.

Between the cooling-tower and the heat-exchange operation stands a newcomer to the system—a Permutit® Automatic Valveless Gravity Filter.

Its job is to clean up a small portion of the main cooling water stream, roughly 1% to 5%. By continuously filtering this small side stream the turbidity of all the cooling water is reduced and held to an acceptably low level.

In the system shown here, suspended matter dropped from 2.0 ppm to 0.5 ppm in just one week, and continued to decrease thereafter.

Less turbidity in the cooling water means less fouling of heat exchange equipment. Less fouling, fewer cleanings, more efficient operation.

Costs nothing to operate: To sweeten your savings a little more, the Permutit Valveless Gravity Filter is automatic, in every sense of the word. It operates itself, backwashes itself. Has no moving parts, requires no attendant, no power, no extra pumps. The water used to wash serves as part of the system blow-off—at no extra cost.

Now in use: Proved in this new application, the Permutit Automatic Valveless Gravity Filter is already saving money for several companies.

All you need, to join them, is a little space near your cooling tower, and a Permutit Automatic Valveless Gravity Filter. For more facts, write: Permutit Division, 50 West 44th Street, New York 36, New York.

*FLUIDICS is the Pfaudler Permutit program that integrates knowledge, equipment and experience in solving problems involving fluids.

PFAUDLER PERMUTIT INC.

A world-wide company with plants in Germany, Great Britain, Canada, Mexico, Japan, as well as the U.S.A.

Technical briefs

Begins on page 92

substitution method (PB 171 219); capacitance, 1 to 1050 uuf, substitution method, 1 mcps (PB 171 220); capacitance, 100 uuf to 1 uf, direct method (PB 171 221); capacitance, 100 to 1150 uuf, direct method, 1 mcps (PB 171 222). *OTS*

Proposed revision of American Standard low-voltage air circuit breakers C37.13 and C37.14, *AIEE working group*

This standard applies to all low-voltage power circuit breakers of the 600-v insulation class capable of interrupting short-circuit currents in excess of 10,000 v-amp for use with ac circuits. It includes service conditions, definitions, temperature limitations and classification of insulating materials, dielectric requirements, nameplate markings, test procedures, design tests and an application guide. *AIEE CP 61-177*

Proposed excitation-system definitions for synchronous machines, *AIEE subcommittee*

This listing covers 46 definitions for terms used in the field of synchronous-machine excitation systems. In addition, proposed definitions are explained and their backgrounds given. *AIEE 61-137*

To obtain complete text

Material for these abstracts comes from the following sources. Order complete publication from source, *not* POWER.

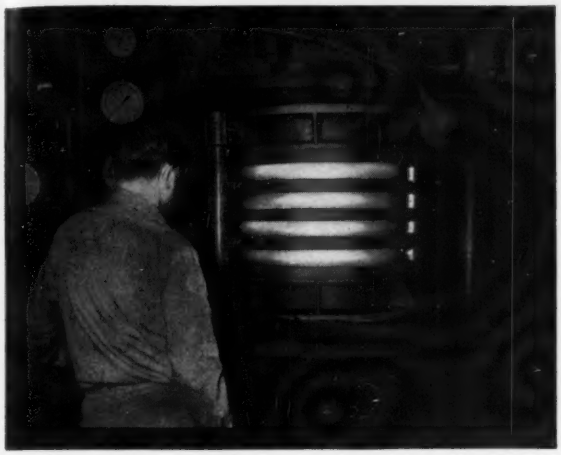
APC. To be published in book form. Contact American Power Conference, Illinois Institute of Technology, Technology Center, Chicago 16, Ill. $8.00.

ASME. Contact American Society of Mechanical Engineers, 29 W 39th St, New York 18, N.Y. Members, 50¢; nonmembers, $1.00.

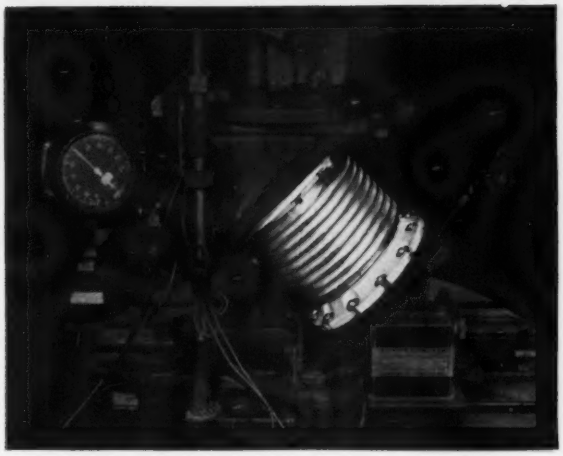
AIEE. Contact American Institute of Electrical Engineers, 33 W 39th St, New York 18, N.Y. Members, 50¢; nonmembers, $1.00.

OTS. Contact Office of Technical Services, U.S. Dept of Commerce, Washington 25, D.C. Prices as shown.

4 WAYS to get maximum reliability in expansion joints



1 Insist that the corrugated bellows be hydraulically formed. The reason is simple. Whenever bellows are formed by circumferential welding . . . whether by edge, seam or fillet welding . . . they will always be subject to premature failure because of stress concentrations at the welds.



2 Be sure the manufacturer maintains a continuous and comprehensive program of endurance testing. This is basic, because of the many variables that affect expansion joint life. Accurate determination of expansion joint life expectancy can only be determined by cycling to destruction.

3 Demand proof that the manufacturer can produce longitudinal welds in the corrugated bellows having the same strength, physical properties and thickness as the parent metal . without grinding. A weld that is hard to find is a ground weld. Variations in weld thickness set up points of stress concentration . . . opening the way for premature failure.

4 Check the ability of the manufacturer to supply a team of *competent* design and application specialists to work with your engineers. Check their specific experience in handling critical, complex applications in your field . . . complete to the record of successes or failures behind them, and details of how this experience will be brought to bear on your problem.

At Zallea, none of the many factors affecting expansion joint reliability are left to guesswork . . . including the four vital ones above.

This is reflected in these facts. Zallea material specifications are the most exacting in the industry. Zallea expansion joints are hydraulically formed. Zallea advanced welding techniques insure welds having the same thickness, strength and physical properties as the parent metal. Zallea has done more cyclic testing to destruction than all government agencies and industrial firms combined. Zallea has produced more expansion joints than any other manufacturer . . . offers more application engineering experience.

For all the facts, write for Catalog 56. Zallea Brothers, Taylor and Locust Streets, Wilmington 99, Delaware.

Zallea for maximum reliability

ZALLEA BROTHERS, Wilmington 99, Delaware • World's largest manufacturer of expansion joints

Marsh Makes It!

If it's a pressure gauge, dial thermometer, or needle valve, Marsh makes it...makes it in every form to suit every need...makes it better in the opinion of thousands of discriminating users. Only a few key products are illustrated here, but hundreds are described in Marsh Catalogs. Ask for information covering the product or products in which you are interested.

PRESSURE GAUGES

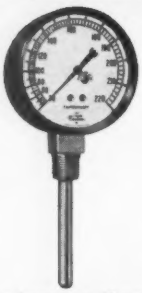
"Mastergauge"—the world's most effective pressure gauge for extreme service.

"Master-test"—"Mastergauge" quality in a gauge for services requiring high accuracy.

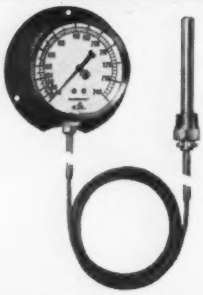
Quality series—second only to "Mastergauge" and "Master-test" for tough conditions.

Standard series—best moderate-priced gauge for run-of-plant conditions.

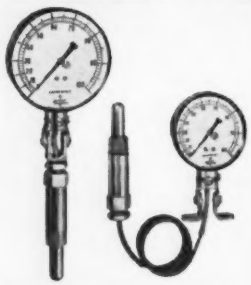
DIAL THERMOMETERS



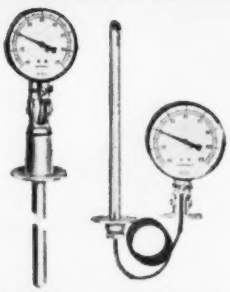
Vapor tension thermometers—direct mounted type. Many sizes; ranges.



Distant reading thermometers—vapor-tension and gas filled types in many sizes; ranges.

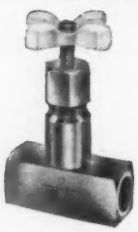


Piping thermometers—specially designed for piping. Types for all purposes, including distant reading.



Duct thermometers—specially designed for all conditions including distant reading.

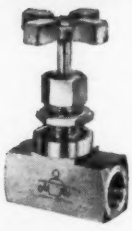
NEEDLE THROTTLING VALVES



Alloy steel—complete series of sizes and patterns. Pressures up to 10,000 psi.

416 Stainless steel—complete series of sizes and patterns in 416 stainless. Pressures up to 10,000 psi.

316 Stainless steel—complete series of sizes and patterns in 316 stainless. Pressures up to 6,000 psi.



Panel mounted—all valves—alloy steel, 416 stainless, and 316 stainless—available in panel mounted types.

MARSH

MARSH INSTRUMENT COMPANY, Dept. F, Skokie, Ill.
Division of Colorado Oil and Gas Corporation
Marsh Instrument & Valve Co., (Canada) Ltd., 8407 103rd St., Edmonton, Alberta, Canada.
Houston Branch Plant, 1121 Rothwell St., Sect. 15, Houston, Texas.
Eastern Seaboard Warehouse: Marsh Instrument Company, 1209 Anderson Ave., Fort Lee, N.J.

For more facts circle 262 on Reader Service card, p 103

Your service center for FREE data

Either of the no-postage Reader Service cards below and p 103B will bring you information on any new equipment listed or product advertised, plus new literature for your files

- **Study new equipment** described in this issue starting on p 118. Circle numbers on card corresponding to items listed
- **Check new literature** available this month beginning on p 103A. To get your personal copies use the card below
- **Read advertisements** and note number listed under each ad. Circle ad numbers on card for complete details
- **Print your name and company on front of card**

May 1961 issue **Circle numbers below for FREE data** Card void after Aug 1, 1961

PLANT EQUIPMENT in the news this month, starting on p 118

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25
26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50
51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75
76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100

NEW LITERATURE listed in this issue, starting on p 103A

101 102 103 104 105 106 107 108 109 110 111 112 113 114 115 116 117 118 119 120 121 122 123 124 125
126 127 128 129 130 131 132 133 134 135 136 137 138 139 140 141 142 143 144 145 146 147 148 149 150
151 152 153 154 155 156 157 158 159 160 161 162 163 164 165 166 167 168 169 170 171 172 173 174 175
176 177 178 179 180 181 182 183 184 185 186 187 188 189 190 191 192 193 194 195 196 197 198 199 200

ADVERTISED PRODUCTS appearing throughout the issue

201 202 203 204 205 206 207 208 209 210 211 212 213 214 215 216 217 218 219 220 221 222 223 224 225
226 227 228 229 230 231 232 233 234 235 236 237 238 239 240 241 242 243 244 245 246 247 248 249 250
251 252 253 254 255 256 257 258 259 260 261 262 263 264 265 266 267 268 269 270 271 272 273 274 275
276 277 278 279 280 281 282 283 284 285 286 287 288 289 290 291 292 293 294 295 296 297 298 299 300
301 302 303 304 305 306 307 308 309 310 311 312 313 314 315 316 317 318 319 320 321 322 323 324 325
326 327 328 329 330 331 332 333 334 335 336 337 338 339 340 341 342 343 344 345 346 347 348 349 350
351 352 353 354 355 356 357 358 359 360 361 362 363 364 365 366 367 368 369 370 371 372 373 374 375
376 377 378 379 380 381 382 383 384 385 386 387 388 389 390 391 392 393 394 395 396 397 398 399 400
401 402 403 404 405 406 407 408 409 410 411 412 413 414 415 416 417 418 419 420 421 422 423 424 425
426 427 428 429 430 431 432 433 434 435 436 437 438 439 440 441 442 443 444 445 446 447 448 449 450

SEARCHLIGHT SECTION for used and rebuilt equipment, starting on p 207

500 501 502 503 504 505 506 507 508 509 510 511 512 513 514 515 516 517 518 519 520 521 522 523 524
525 526 527 528 529 530 531 532 533 534 535 536 537 538 539 540 541 542 543 544 545 546 547 548 549 550

SAVE $4 ON YOUR OWN SUBSCRIPTION TO POWER
Yes, start sending my personal copies: U.S. 36 issues for $6 ☐ Canada, $10 ☐
Bill me later ☐ Bill my company ☐

NOTE: Fill in your name and business address on other side of card→

New free literature

General equipment and key materials for systems engineering

• Instruments

101 **Multipoint** controllers, 10-point, off-on potentiometer or bridge, are illustrated in 8-p catalog 52. Specs cover unit's use with standard sensing elements. Thermo Electric Co, Inc

102 **Electricity-distribution programs** for manufacturer's digital computer are covered in reports from Bendix Computer Div

103 **Externally adjustable** pressure and differential pressure switches for 15-to-200-psi differential range are outlined in data sheet E9. Units open or close circuit when pressure becomes too high or low. Pall Corp

104 **High-speed** basic, medium and large computer systems are depicted in 20-p brochure QC-020-R110. Chapters include programming, accessories and specs. Bendix Computer Div

105 **Computer selection** is topic of 5-p nontechnical booklet. System analysis, specs, design and operation of computer are given. Philco Corp, Computer Div

106 **Voltage-to-frequency converter** is detailed in spec sheet. Unit can serve as a digital integrator. Lome Electronics, Inc

107 **High-speed** electronic temperature monitor is subject of reprint 100. Unit scans up to 3600 inputs in 0.8 sec. Monitor Systems, Inc

108 **Temperature-control systems** are topic of 8-p catalog F-8031-1. Components of graphic-panel and identification control centers are described. Barber-Colman Co

• Maintenance

109 **Piston-ring** selection and application for large-bore diesel and gas-burning engines is covered in 8-p booklet from Piston Products, Inc

110 **Metal-cleaning** process features sludge removal without shutdown. See data sheet available from Kolene Corp

111 **High-frequency** electric tools including grinders, impact wrenches, drills and balancers are featured in 32-p catalog. Specs, applications and accessories are listed. Thor Power Tool Company

• Piping, valves, fittings and specialties

112 **Asbestos-cement** water-pipe products are described in 10-p brochure TR-254A. Design data, details of application on cooling-water supply, distribution lines are included. Johns-Manville

113 **Impulse-steam-trap** selector and piping-diagrams booklet for petroleum-processing equipment, 32 pp, includes sizing, installation info, 26 capacity tables. Yarnall-Waring Company

114 **Check valve** featuring simplified design is subject of 4-p folder 672-60-5M. Dominion Engineering Co, Ltd

115 **Bonnetless knife-gate valve** for use on fibrous and slurry lines and corrosive services is topic of 4-p circular 301. DeZurik Corp

PLEASE TYPE OR PRINT

Your Name .....

Position .....

Company .....

Co. Address .....

City and State.....

Is this your personal copy of POWER?

Yes ☐ No ☐

FIRST CLASS
PERMIT No. 64
NEW YORK, N. Y.

BUSINESS REPLY MAIL
NO POSTAGE STAMP NECESSARY IF MAILED IN THE UNITED STATES

POSTAGE WILL BE PAID BY—

Power

READER SERVICE DEPARTMENT

330 WEST 42nd ST.

NEW YORK 36, N. Y.

26th FLOOR

Circle key numbers, page 103, for your copies

Air-conditioning systems 103B
Electrical systems 103B
Steam, hot-water systems 106
Fluid-handling systems 108
Nuclear systems 110
Mechanical transmission systems 110
Energy-systems services 112

116 **Solenoid valves** for oil pressures to 3000 psi are subject of data sheet. Normally open or closed types, valves are pilot-operated in cartridge form. Fluid Power Accessories, Inc

117 **Automatic** motorized zone-control and backpressure-relief valves are topic of 12-p booklet from A W Cash Valve Mfg Corp

118 **Expansion** and solenoid valves, strainers, liquid level and pilot controls are chapters of 16-p catalog 58. Sporlan Valve Company

119 **Sight flow indicators,** flapper and rotary with threaded and flanged connections, are subject of 4-p bulletin 18W. Installed directly in pipelines, instruments let you look right at the fluid. Schutte and Koerting Company

120 **End fittings** for low-, medium- and high-pressure hose assemblies are described in 4-p pamphlet IEB-58. Aeroquip Corp

121 **Steel and brass** tube fittings and hose are features of 16-p catalog C-301. The Weatherhead Company, Fort Wayne Div

Air-conditioning systems

122 **Packaged** liquid chiller and accessories are topic of 4-p brochure. Curtis Mfg Company

123 **Maintenance** of water-cooled air-conditioning systems is subject of data sheet T-51. Associated Laboratories, Inc

124 **Cooling towers,** single, double flow and modular design, are covered in 4-p pamphlet. Fiske Company

125 **Cleaner** after a hermetic-motor burn-out on air-conditioning or refrigeration system is topic of 4-p bulletin 40-10-1. Installation is diagramed. Sporlan Valve Company

• **Ventilation**

126 **Exhaust** and ventilating fans are pictured in 4-p folder from Barry Blower Co

127 **Direct-drive** centrifugal roof ventilator is subject of 8-p bulletin 4104. Selection and rating tables and installation drawings are given. American-Standard Industrial Div

• **Filtration**

128 **Automatic** dust collector applications are outlined in folder. Depicts self-cleaning mechanism and other components. Automatic Collector Div, Torit Mfg Co

129 **Panel,** grease, oil-bath and roll type filters are described in 4-p circular from Continental Air Filters Inc

Electrical systems

130 **Equipment** for cement plants is topic of 16-p booklet B-7891. Chapters include control centers, motors and drives, electrical distribution and maintenance services. Westinghouse Electric Corp

131 **Interlock switches** automatically cut power when service door is opened, eliminating danger of tying down or wiring around conventional switches. See 4-p

May 1961 issue **Circle numbers below for FREE data** **Card void after Aug 1, 1961**

PLANT EQUIPMENT in the news this month, starting on p 118

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25
26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50
51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75
76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100

NEW LITERATURE listed in this issue, starting on p 103A

101 102 103 104 105 106 107 108 109 110 111 112 113 114 115 116 117 118 119 120 121 122 123 124 125
126 127 128 129 130 131 132 133 134 135 136 137 138 139 140 141 142 143 144 145 146 147 148 149 150
151 152 153 154 155 156 157 158 159 160 161 162 163 164 165 166 167 168 169 170 171 172 173 174 175
176 177 178 179 180 181 182 183 184 185 186 187 188 189 190 191 192 193 194 195 196 197 198 199 200

ADVERTISED PRODUCTS appearing throughout the issue

201 202 203 204 205 206 207 208 209 210 211 212 213 214 215 216 217 218 219 220 221 222 223 224 225
226 227 228 229 230 231 232 233 234 235 236 237 238 239 240 241 242 243 244 245 246 247 248 249 250
251 252 253 254 255 256 257 258 259 260 261 262 263 264 265 266 267 268 269 270 271 272 273 274 275
276 277 278 279 280 281 282 283 284 285 286 287 288 289 290 291 292 293 294 295 296 297 298 299 300
301 302 303 304 305 306 307 308 309 310 311 312 313 314 315 316 317 318 319 320 321 322 323 324 325
326 327 328 329 330 331 332 333 334 335 336 337 338 339 340 341 342 343 344 345 346 347 348 349 350
351 352 353 354 355 356 357 358 359 360 361 362 363 364 365 366 367 368 369 370 371 372 373 374 375
376 377 378 379 380 381 382 383 384 385 386 387 388 389 390 391 392 393 394 395 396 397 398 399 400
401 402 403 404 405 406 407 408 409 410 411 412 413 414 415 416 417 418 419 420 421 422 423 424 425
426 427 428 429 430 431 432 433 434 435 436 437 438 439 440 441 442 443 444 445 446 447 448 449 450

SEARCHLIGHT SECTION for used and rebuilt equipment, starting on p 207

500 501 502 503 504 505 506 507 508 509 510 511 512 513 514 515 516 517 518 519 520 521 522 523 524
525 526 527 528 529 530 531 532 533 534 535 536 537 538 539 540 541 542 543 544 545 546 547 548 549 550

SAVE $4 ON YOUR OWN SUBSCRIPTION TO POWER
Yes, start sending my personal copies: U.S. 36 issues for $6 ☐ Canada, $10 ☐
Bill me later ☐ Bill my company ☐

NOTE: Fill in your name and business address on other side of card→

NEW FREE LITERATURE continued ..... circle key numbers, page 103, for your copies

folder 186 from Micro Switch Div, Minneapolis-Honeywell Regulator Company

132 **National Electric Code** requirements for installation and operation of portable electric tools and equipment are listed in revised 8-p booklet. The Arrow-Hart & Hegeman Electric Company

133 **National Electrical Code** and conduit applications in hazardous locations are topics of 60-p catalog 2723. Crouse-Hinds Company

• Generation, transformation and conversion

134 **Ac generators** in ratings from 3.75 to 62.5 kva are detailed in spec sheet. Nonpackaged machines feature large terminal box, end-to-end ventilation and prelubricated bearings. Electric Machinery Mfg Company

135 **Gasoline- and diesel-driven** electric-generating plants are listed on spec sheet from Onan Div, Studebaker-Packard Corp

136 **Single- and 3-phase** dry type transformers are detailed in 36-p catalog. Wiring diagrams, specs and prices are given. Atlantic Transformer Company

• Distribution and protection

137 **Silicone-insulated cable** 4-p bulletin illustrates power and lighting cable, hook-up wire and conductor cable for nuclear power purposes. Second 4-p bulletin outlines silicone-rubber-cable application case histories. Boston Insulated Wire and Cable Co

138 **Generator controls** and transfer switches are topics of 4-p circular 1260. Auxiliary controls are shown. Lake Shore Electric Corp

139 **Power system** maintains regulated ac for distribution system and assures minimum voltage dip on motor starting across line. See 8-p bulletin 45-200 from Electric Products Company

140 **Current-limiting** and concrete-cast reactors for distribution systems rated 34.5 kv and below are described in 16-p catalog GEA-976E. Units protect apparatus from short-circuit-released flow of energy. General Electric Company

141 **Power protector** permitting safer entrance up to 480-v ac is topic of GEA-6527-1. 6-p brochure GED-4269 features 1-v switchgear. General Electric Company

142 **Power-control-panel** specs are given in 16-p bulletin GET-3041. Squirrel-cage, synchronous-motor and wound-rotor-motor starters, incoming-line, feeder-circuit and secondary breakers are detailed. General Electric Company

• Application

143 **Oil-filter presses** and purifiers for reconditioning insulating liquids in circuit breakers, transformers are subject of 4-p bulletin GEA-7141. General Electric Company

144 **Nonshattering covers** for watthour socket meters are shown in

PLEASE TYPE OR PRINT

Your Name .....

Position .....

Company .....

Co. Address .....

City and State.....

Is this your personal copy of POWER?

Yes ☐ No ☐

FIRST CLASS
PERMIT No. 64
NEW YORK, N. Y.

BUSINESS REPLY MAIL
NO POSTAGE STAMP NECESSARY IF MAILED IN THE UNITED STATES

POSTAGE WILL BE PAID BY—

Power

READER SERVICE DEPARTMENT

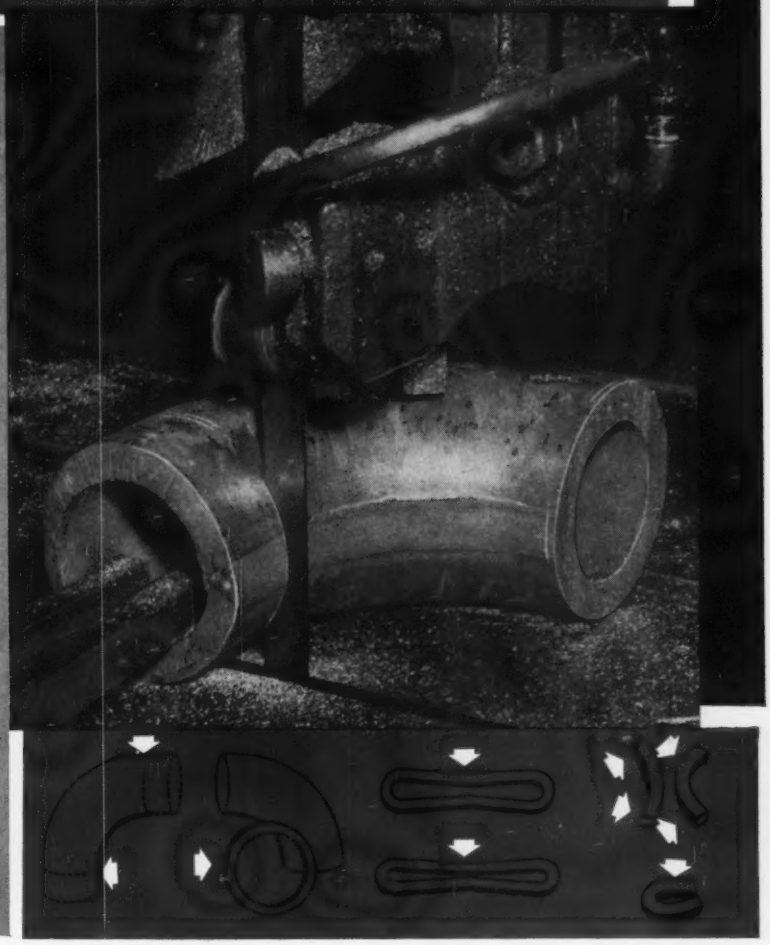
330 WEST 42nd ST.

NEW YORK 36, N. Y.

26th FLOOR

Extra Length of fitting used for testing purposes

NO EXPENSIVE DUPLICATES NEEDED for destructive tests on MIDWEST nuclear fittings



1. Fitting is made with extra long tangents.
2. Tangents are cut off both ends.
3. One of the resulting rings is flattened in a press, in accordance with specifications, and closely examined for possible defects.
4. For welded-type fittings a section of the other ring, including weld, is bent back upon itself, and inspected for evidence of fissuring or other discontinuities.

Midwest's unique method of obtaining specimens for destructive tests assures an extremely accurate and dependable basis for testing... without manufacturing expensive representative samples! Tension tests, corrosion tests, and photomicrographic studies are also performed on tangents cut from the finished fitting assuring dependability beyond comparison.

Write for new brochure: Critical Piping for the Nuclear Age

MIDWEST PIPING A DIVISION OF CRANE CO.
1450 S. SECOND ST. • ST. LOUIS, MISSOURI

6008

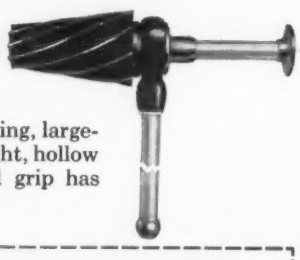
World's Fastest, Smoothest Hand Reaming

Self-Feeding RIDGID® No. 2-S Spiral Reamer

. . . reams pipe, conduit, sheet metal and wood!

Try a RIDGID Spiral Reamer, and you'll quickly feel how it reams its way into pipe, conduit, metal holes or wood without effort. Heat-treated cutting edges give maximum service life. Ratchet-action handle makes work easy in close quarters.

Now Available . . .
RIDGID No. 254 Spiral Reamer
for 2½" to 4" Pipe and Conduit



No more hand filing . . . here's the time-saving, large-size hand reamer you've always needed. Light, hollow construction makes handling easy. Hand grip has large butt plate for body pressure.

Call your Distributor today. For your convenience, he maintains a complete stock of RIDGID Work-Saver Pipe Tools and parts!

RIDGID
The Ridge Tool Company, Elyria, Ohio, U.S.A.

Free literature

Begins on page 103

data sheet. Seal-tight rim eliminates gasket and provides integral locking. Busada Mfg Corp

145 **Part-winding** starting, d-flange multi-speed and integral-hp-vertical motors are topics of bulletins 1465, 1430, 1300 and 1485. Century Electric Company

146 **Heavy-duty** synchronous motors rated 600 hp and up are feature of spec sheet 1100-PRD-253. Electric Machinery Mfg Company

147 **Right-angle** worm-gear motors are pictured in 4-p folder F-1971. Ratings and dimensions are given for single- and double-reduction motors. U. S. Electrical Motors, Inc

148 **Manual starters** for fractional-hp motors have built-in thermal relays. 8-p brochure 10-B1 is available from Furnas Electric Co

Steam and hot-water systems

- **Fuel handling**

149 **Prevention** methods for tube failures in high-pressure steam generators are examined in 8-p booklet. Dow Industrial Service Div

150 **Flexible** polyethylene inserts for steam-condenser tubes protect ends from erosion and impingement. 4-p folder features standard and expanded inserts for new and used tubes. Tennant Development Corp

- **Controls**

151 **Automatic sequence control** for pneumatic materials-handling systems is described in 4-p circular EEb. Dimension drawings and schematic diagram for typical system are included. Allen-Sherman-Hoff Company

152 **Triple-fuel** draft control for oil-, gas- and coal-fired furnaces and boilers is topic of 4-p guide. Heating and processing equipment applications are subject of 12-p booklet. Field Control Div, Conco Engineering Works, Inc

153 **Flame detector** monitors fuel-burning equipment using coal, gas or oil. Data sheet E66-2 is available from Bailey Meter Company

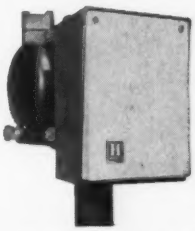
154 **Design** and selection of combustion-control systems is detailed in 32-p bulletin 1001. Proportioning and metering systems are diagramed. Reliance Instrument Div, Electro-Mech Corp

155 **Water columns** give alarm when boiler water level gets too high or low; subject of spec sheet 395. Jerguson Gage & Valve Company

continued

NEW BELLOWS FLOW TRANSMITTER

gives you field indication plus convenience and precision



You get all the economy and convenience of pneumatic transmission and all the efficiency of the bellows meter body plus field indication, when needed, in the new Honeywell Bellows Flow Transmitter. Use it in any application to transmit flow or liquid level measurements in open or closed tanks.

This new meter has automatic ambient temperature compensation and two-way overload protection for 100% of span. Maintenance is greatly simplified by modular construction which lets you remove any major component by loosening two screws. All field adjustments are easily accessible, and a self-locking feature prevents upset after calibration adjustments are made.

You can change ranges in the field simply by removing a single spring assembly and replacing it with an assembly of the desired range . . . adjust damping quickly and accurately, while the instrument is in operation . . . install the meter with either vertical or horizontal piping, so that it vents, drains and purges itself. The meter transmits with calibrated accuracy of ±0.5% of full scale, and indicates within ±1.0% of full scale.

For complete details on the new Bellows Flow Transmitter, call your nearby Honeywell field engineer. Or write MINNEAPOLIS-HONEYWELL, Wayne and Windrim Avenues, Philadelphia 44, Pa.—In Canada, Honeywell Controls, Ltd., Toronto 17, Ontario.

New Bellows Transmitter is available with a concentric scale or as a non-indicator. It has 16 ranges—from 0-10 inches of water to 0-400 inches of water.

Honeywell

First in Control

SINCE 1885

For more facts circle 265 on Reader Service card, p 103

SAVE SPACE and REDUCE COSTS

with

AURORA®

VERTICAL END-SUCTION PUMPS

Capacities to 1800 GPM
Heads to 320 Feet

This close-couple, vertical mounting design provides the extreme compactness that is so important for the many applications where space allocation is critical. Flanged suction mounting cuts piping costs by direct mounting to tank. Separate foundation arrangement is eliminated along with any alignment problems. Optional discharge arrangement permits the most simplified installation.

The many desirable features of the Horizontal End Suction Pumps are retained . . . motor and rotary assembly easily removable without disturbing the suction or discharge piping . . . low NPSH . . . smooth quiet operation. Available in vertical base mounting design as well as close coupled or flexible coupled horizontal models.

WRITE TODAY FOR BULLETIN

AURORA Always PUMPS

AURORA PUMP DIVISION
THE NEW YORK AIR BRAKE COMPANY
1000 LOUCKS • AURORA, ILLINOIS

LOCAL DISTRIBUTOR IS LISTED IN THE YELLOW PAGES OF YOUR PHONE BOOK

Free literature

Begins on page 103A

Fluid-handling systems

• **Water treatment**

156 **Fluid-handling** drive for aeration equipment is available with seal or stuffing box and fixed- or variable-speed belts. Specs are given in 8-p bulletin 1001 from The Pfaudler Company

157 **"Cooling-** and circulating-water problems" is title of 4-p article. Chapters deal with troubles in hot- and chilled-water systems, diesel and gas engines, compressors, cooling towers. Associated Laboratories, Inc

• **Pumps**

158 **Sealless, leakproof** pumps are features of spec sheets 1030-3 and 1052-1. Chempump Div, Fostoria Corp

159 **Single-stage** centrifugal pumps from −350 F to +1000 F are described in 12-p circular 184. Materials specifications are given. Dean Brothers Pumps Inc

160 **End-mounted** centrifugal turbine pumps are topic of 36-p booklet. Motor selection, gravity and viscosity conversion are chapters; features 84 performance curves and calculations. The Roy E Roth Company, Turbine Pump Div

161 **Adjustable - speed** drives for pumping applications are discussed in 8-p brochure 5560. Drive-selector guide covers municipal water-treatment stations, constant-pressure and pipeline pumping. Westinghouse Electric Corp

162 **Single**-stage centrifugal pumps with capacities to 775 gpm and heads to 300 ft are detailed in 16-p bulletin 725.8. Bulletin gives bearing-life and shaft-deflection data and frame-selection chart. Goulds Pumps, Inc

• **Controls**

163 **Meter** measures steam, air or gas in 1-in. lines and larger. 4-p folder 400.20-1 features pressure-compensating counter which corrects readings for line pressure variations. B-I-F Industries, Inc

164 **Recording** type controllers operate diaphragm motor valves for controlling steam or liquid flow; subject of 4-p circular 335. Stickle Steam Specialties Co

165 **Indicator** of gas and fluid pressure, thrust and torque is shown in data sheet P-60236. Adjustment and calibration procedures are given. Taber Instrument Corp

166 **Pressure switch** for water systems and air compressors is detailed in spec sheet 69B2 from Furnas Electric Company

continued

Lined against corrosion with gunited concrete

The lining being applied – of corrosion-resistant concrete made with LUMNITE calcium-aluminate cement and insulating aggregate – will soon be protecting stack and breeching from the corrosive action of flue gas condensate.

It will also keep stack gases hot, maintaining better draft for greater operating efficiency. Steel shells will stay cooler, extending exterior paint life. And monolithic concrete linings have lower unit weight, reducing dead load on supporting structure. Gunited or plastered, installation is easy and economical, with the concrete reaching service strength in 24 hours. For convenience, manufacturers of refractories offer castables bonded with LUMNITE cement – packaged mixtures ready to use by adding only water.

For more information, write Universal Atlas, 100 Park Avenue, New York 17, N. Y.

Offices: Albany • Birmingham • Boston • Chicago • Dayton • Kansas City • Milwaukee • Minneapolis • New York • Phila. • Pittsburgh • St. Louis • Waco

"USS," "ATLAS" AND "LUMNITE" ARE REGISTERED TRADEMARKS L-213

Universal Atlas Cement
Division of
United States Steel

USS

NOW...

even better than ever Nicholson Thermostatic Steam Traps

NEW Steam Saving BAFFLE*

Live steam, entering the trap, is instantly deflected upward and away from the orifice to surround the bellows. Faster snap-close action occurs, positively preventing live steam loss. Maximum steam-saving efficiency . . . confirmed by recent tests.†

This makes a fine trap even better . . . a trap you could *always* depend on for powerful, intermittent discharge, positive shut-off . . . and up to 6 times the capacity of ordinary traps. If you would like to try one *free*, ask your Nicholson representative . . . or write directly to us.

† *U.S. Testing Co. Report #75955, December 26, 1960.* **Patent applied for.*

Our 80th Year

W. H. NICHOLSON and COMPANY
12 Oregon Street • Wilkes-Barre, Pa.

Free literature

Begins on page 103A

167 **Control** and regulation equipment for steam, water, air, oil and gas is covered in 4-p booklet available from McAlear Mfg Company

168 **Flow-metering** differential producers—venturi tubes and nozzles and flume liner—are illustrated in 8-p catalog. B-I-F Industries

169 **Liquid-blending** systems are topic of 8-p bulletin 650. Equipment is designed for 1 to 2000 gpm. Blackmer Pump Company

• **Filters**

170 **Submerged** leakproof filter systems, chambers featuring visibility during operation and stainless-steel filter chambers are subjects of bulletins 551A, 401 and 402. Sethco Mfg Corp

171 **Epoxy-constructed** filter systems and stainless-steel chambers are topics of spec sheets 802 and 402. Sethco Mfg Corp

Nuclear systems

172 **Nomograph** for computing approximate costs of building atomic-hardened structures was derived from records of actual installations. Burns and Roe, Inc

173 **Radiation-detection** equipment is described in 4-p brochure. Integrated and individual monitoring systems and gamma spectrometer are shown. Nuclear Measurements Corp

174 **"Nuclear problems** handled with X-rays" is title of 4-p article. Analytical procedure for uranium-fuel-alloy ingots is discussed. Philips Electronic Instruments, Div of Philips Electronics & Pharmaceutical Industries Corp

175 **Self-contained** gamma alarm system operates from 110-v circuit. Unit, outlined in 4-p pamphlet GA-2, is insensitive to electromagnetic disturbances. Nuclear Measurements Corp

Mechanical transmission systems

176 **Couplings,** grid-groove design, protect machines from shock and vibration. Revised bulletin 4100 presents charts and tables in its 32 pp. Chapter on selection is included. The Falk Corporation

177 **"How to plan** and install your own conveying system" is title of 20-p guide 500. Typical installation plans and check list to help select right conveyors are features. Conveyor Systems, Inc, A B Farquhar Div

continued

SEL-REX RECTIFIER HELPS MAKE THE "LUBES" THAT KEEP MISSILES FROM BEING EATEN ALIVE!

At Hooker Chemical Corporation's Niagara Falls, N.Y. plant, a Sel-Rex rectifier supplies the current for an electrochemical operation important to the U.S. Space Program. It is production of fluorine, basic element of Hooker Fluorolubes®.

Polymers of trifluorovinyl chloride, Fluorolubes are made as non-flammable light oils, heavy bodied oils and greases. Their job is to protect missiles from their own corrosive chemical fuels—the metal-eating, highly-destructive action of pure oxygen, hydrogen peroxide and concentrated nitric acid.

According to Robert F. Schultz, production manager of Hooker's Eastern Chemical Division, the unit supplying current to the fluorine cells must provide uninterrupted, trouble-free service. To date, his Sel-Rex silicon rectifier "has met all expectations; it has proven completely reliable, presenting no maintenance problems and requiring little or no attention."

And for *your* special current needs—for reliable, continuous conversion of A.C. to D.C.—choose Sel-Rex, the industry-proved rectifiers that more than pay for themselves in unequalled dependability and maintenance-free service.

Send for Free "GUIDE" to Industrial Rectifier Equipment

A slippery blanket of Hooker-made Fluorolubes protects missile parts, serves as a lubricant, sealant. A Sel-Rex silicon rectifier supplies the current required to make fluorine, an essential ingredient. "Our Sel-Rex rectifier," states a company official, "has given us the high standard of dependable performance required for our operation."

Complete Semi-Conductor Power Conversion Equipment and Systems for any AC to DC Application

SINCE MEAKER 1899

THE MEAKER COMPANY

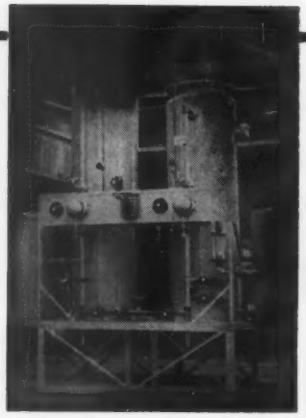
SUBSIDIARY OF SEL-REX CORPORATION

Nutley 10, New Jersey

Factories and offices Chicago 50, Ill., Los Angeles, Cal. and Nutley 10, N. J.

Representatives in principal cities.

For more facts circle 269 on Reader Service card, p 103



NEW FROM H&T
Low-Cost • High-Performance
"PACKAGE" DEMINERALIZERS!
TWO-BED and UN-A-BED
STANDARD UNITS

NOW AVAILABLE!!

Unless *special* conditions require you to use a *special* demineralizing system, you can save big money—and get excellent results—with the new H&T Standard "PACKAGE" DEMINERALIZER! Into these superior Standard Units, we've put the experience of 16 years in building many hundreds of manual and automatic demineralizing systems. *Result:* H&T "PACKAGE" DEMINERALIZERS are masterpieces of design and construction—unequalled in performance and wonderfully low in cost.

Write for details of Two-Bed and Un-A-Bed Demineralizers

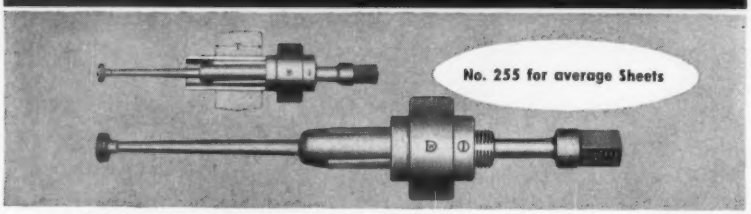
H&T SERVICE

HUNGERFORD & TERRY, INC.
CLAYTON 3, NEW JERSEY

For more facts circle 270 on Reader Service card, p 103

IDEAL WIEDEKE • DAYTON • TUBE EXPANDERS

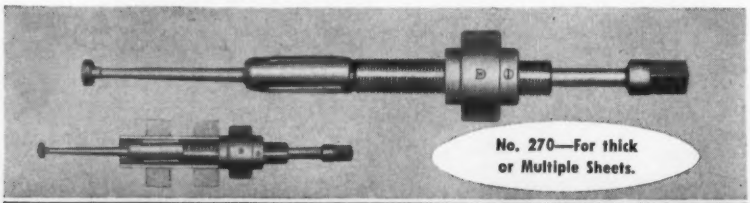
WIEDEKE Precision-Built Tube Expanders



Ball Bearing Adjustable Thrust Collar Tube Expanders are made for Tubes ¼" diameter and larger.
Recommended for use with any Controlled Rolling Motor for uniform expansion of Tubes.

See your Dealer or write us for Bulletin.

For Rolling—Heat Exchanger, Condenser and other Heat-Transfer Tubes.



THE GUSTAV WIEDEKE COMPANY
DAYTON 1, OHIO

For more facts circle 271 on Readers Service card, p 103

Free literature

Begins on page 103A

178 **Adjustable-speed** drives for application in ¾- to 2500-hp drive range are shown in 6-p booklet 2900. Speed ranges, ratings and associated controls are given. The Louis Allis Company

179 **Chain drives** are cataloged in 92 pp. Selection procedures and application data are given with tables, charts and formulas to locate dimensions, capacities, hp ratings and specifications. The Whitney Chain Company

180 **V-belts,** malleable-iron bushing system, roller chain and sprockets are some topics in 24-p catalog GC-101-F available from Browning Mfg Company

181 **Light-,** medium- and heavy-tonnage conveyors are discussed in 8-p illustrated brochure. Syntron Company

182 **Oilless bearings** operate in range of −270 to +375 F. 12-p catalog 511 lists cylindrical and flange bearings. Arguto Oilless Bearing Company

183 **V-belt clutch** selection is covered in 16-p booklet 40. General-purpose, heavy-duty and ball-bearing clutches are described. V-Belt Clutch Company

Energy-systems services

184 **Water-service** organization offers 4-p brochure 10 with info on well systems, pumps, drilling and equipment. Layne & Bowler, Inc

185 **World-wide** operations of manufacturer of metal-cleaning and finishing and dust- and fume-control equipment are outlined in 16-p bulletin. Wheelabrator Corp

186 **Facilities,** products and markets are discussed in 20-p booklet B-6429 aimed at users of air-conditioning and -handling, heat-transfer and fluid-drive equipment. Applications in buildings and industrial and utility plants are described. American-Standard Industrial Div

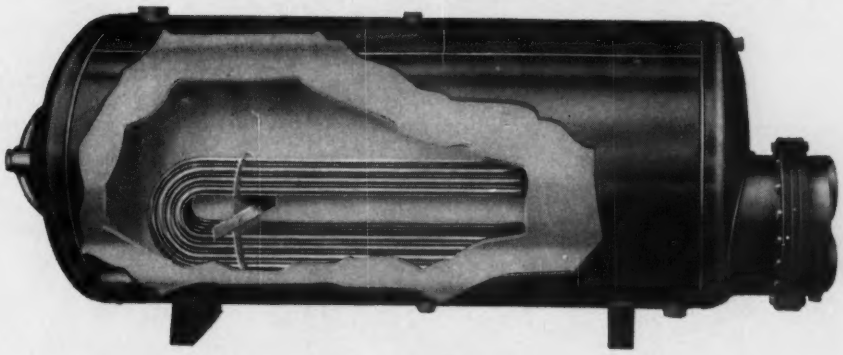
EDITOR'S NOTE: *The following bulletins may be requested directly from the manufacturer. Write on company letterhead to addresses listed below:*

★ **High-vacuum** mechanical and diffusion pumps, valves, gages and accessories are described in 8-p brochure. NRC Equipment Corp, 160 Charlemont St, Newton 61, Mass.

★ **Data sheet** describes chemical and physical properties of compound that controls fungi, bacteria and marine organisms. Clear liquid can be used in industrial cooling systems, paper mills. Metal & Thermit Corporation, Rahway, N. J.

NOW! PRE-KRETE® FACTORY LININGS

Guaranteed



Five Years

UNCONDITIONALLY WITHOUT QUALIFICATION

The Pre-Krete factory-installed lining you specify today will be in perfect condition in 1966 . . . or P-K will repair or replace it free of charge! This new five-year unconditional, *un-prorated* guarantee covers materials and labor. It applies to all factory lined P-K storage water heaters. • After five years? Pre-Krete cures in hot water, gets better as it ages. Chances are it will last almost indefinitely. • A Pre-Krete rust- and corrosion-resistant hydraulic cement lining doubles the life of a plain steel heater, yet costs only slightly more. Special additives make the ¾" coating extra durable. It doesn't chip, crack or flake even at temperatures up to 900°F. And, there are no weak spots or "holidays", because Pre-Krete is always uniform — a result of precision blending. Maintenance costs, of course, are lowered appreciably. • P-K Pre-Krete lined storage water heaters are economical to buy, install and operate. • Designs are advanced in concept and fabrication techniques meet all ASME specifications. • We'll gladly send you our descriptive catalog and more information. Write Patterson-Kelley Co., Inc., 85 Burson Street, East Stroudsburg, Penna.

Patterson Kelley

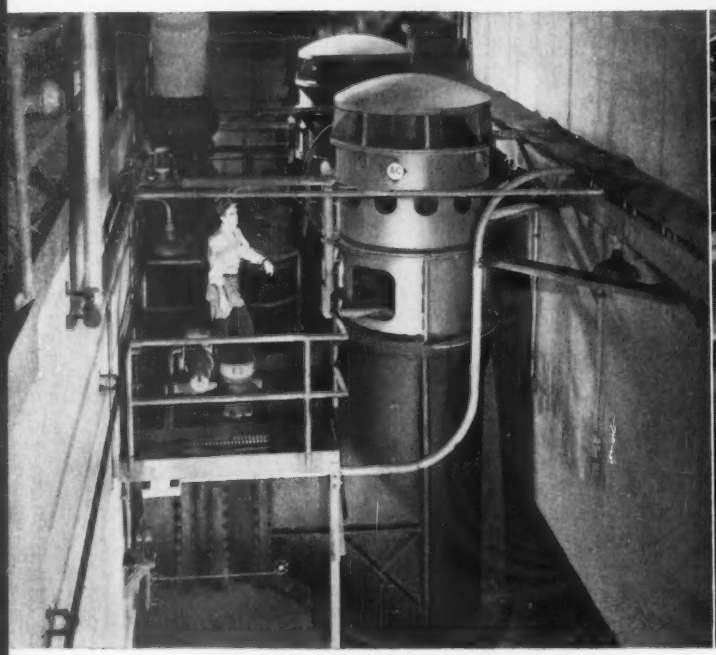
Water Heater Division

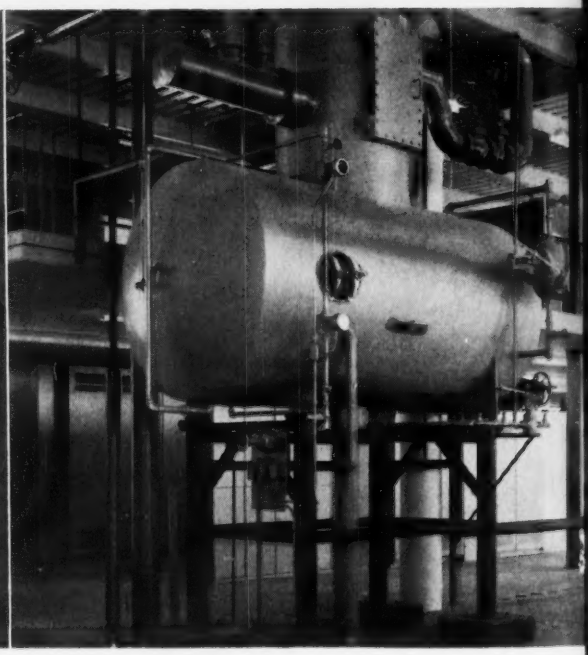
For more facts circle 272 on Reader Service card, p 103

Current news reports

WHAT'S HAPPENING IN POWER SERVICES?

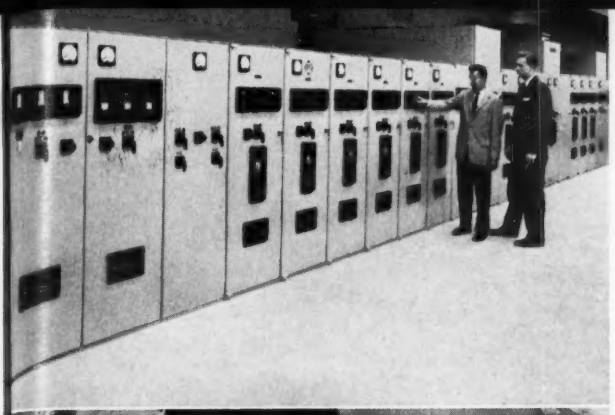
Highlights: Switchgear with the lowest silhouette on the market. A "guided flow" condenser that slashes space requirements. These examples demonstrate the extra value that is standard with Allis-Chalmers . . . the greater efficiency and the added productivity that are yours when you buy A-C products, systems and services. Call your nearby Allis-Chalmers office for details or write Allis-Chalmers, Industries Group, Milwaukee 1, Wisconsin.



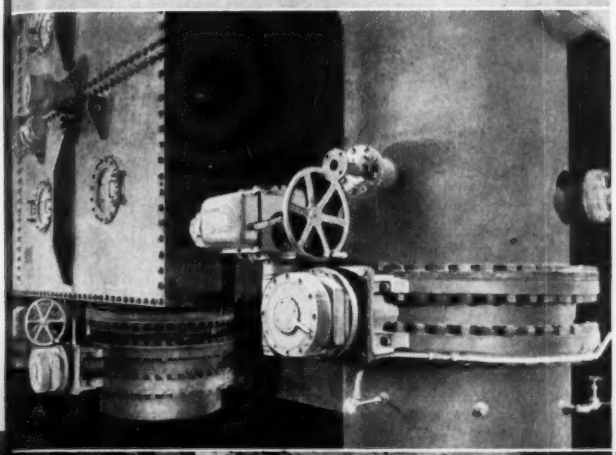


Rugged construction for continuous operation at highest possible efficiencies — yours with these condenser circulating water pumps and vertical induction motors. All pumps are tested at rated head and capacity to assure guaranteed performance. Available in a wide variety of materials to meet your installation needs. *Super-Seal* motors, with *Silco-Flex* insulation, assure complete reliability for outdoor installations and areas with high humidity or contaminated atmospheres.

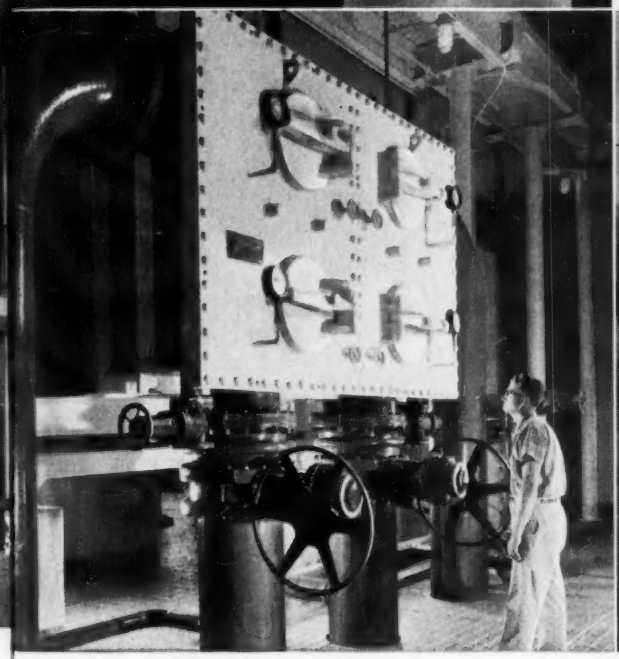
Stainless steel "scorns" corrosion — It's standard with all Allis-Chalmers tray-type deaerator internals. This 90,000 lbs. per hour "package" unit removes oxygen and other corrosive gases besides heating boiler feedwater. Heating and distributing tray design provides greater spillage edge — extra-efficient air separating trays remove more oxygen and gases through full counterflow design. Protects boiler and associated steam and condensate equipment from corrosive attack.

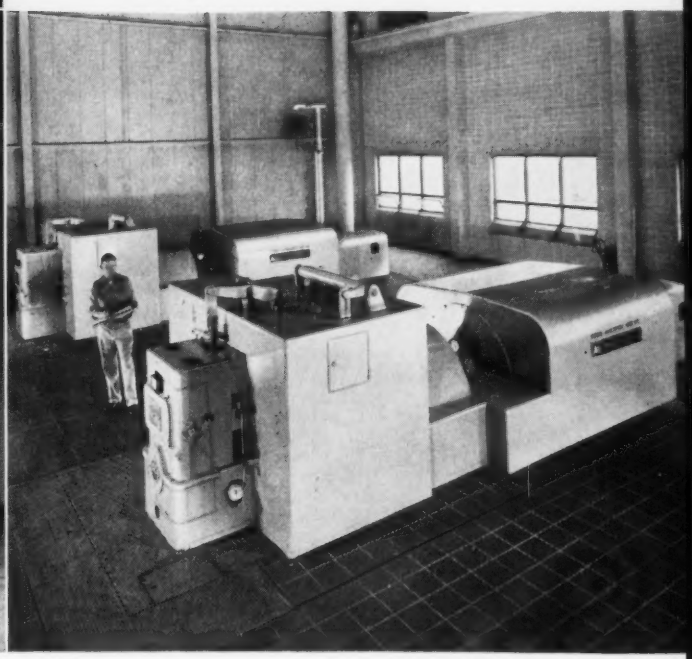


Lowest height, easiest access 5-kv metal-clad switchgear on the market. Just 72 inches high, you get eye-level instrumentation, shoulder-height accessibility of component parts. Other outstanding advantages: front-accessible current transformers; maximum compartmentation and dead-front construction for greater safety; full-panel metering; rapid, one-stroke breaker insertion. Choice of stored energy or solenoid operated circuit breakers.



Eliminate tuberculation and oxidation, reduce maintenance with rubber-seated butterfly valves. Operation is always extra-smooth and easy with 100% effective shutoff. Full body protection is offered by a rubber seat that extends through the valve body and over the flange faces. Angle seating protects the rubber seat and permits seating adjustment without costly disassembly. Being light and compact, these valves require less space and support than most other types.





Extra-compact rectangular steam condenser shape reduces space requirements. "Guided-flow" design achieves highest efficiency and vacuum with available water temperatures . . . gets maximum temperature condensate at the hotwell. Internal reverse-flow design for cooling water effectively backwashes debris, ends costly shutdown, conserves space, requires no additional piping. Planned-as-a-package auxiliary condenser equipment also available.

Two non-condensing, automatic extraction steam turbine-generator units (3000 kw) — for a hospital center where extraction and exhaust steam are used for heating and other services. You get the advantages of two steam pressures — high pressure by automatic extraction and low pressure from the exhaust. Use of pressure-reducing valves and desuperheaters is minimized where a wide range of process pressures is desired.

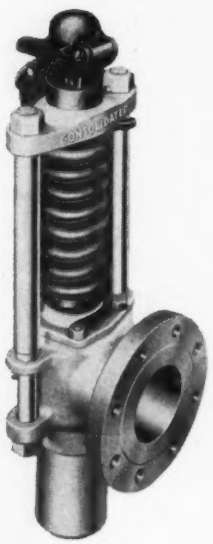
Super-Seal and *Silco-Flex* are Allis-Chalmers trademarks.

ALLIS-CHALMERS

A-1479

greater capacity

CONSOLIDATED "MAXIFLOW" SAFETY VALVES set a new standard of capacity and tightness in high pressure steam service



Consolidated "Maxiflow" Safety Valve, Type 1700 Series. Sizes: 1½" through 6". Pressure to 3000 psi. Temperatures to 1120° F. for superheater and reheater service.

Consolidated "Maxiflow" Safety Valves have greater discharge capacity, seat tightness, and shorter blowdown essential to optimum service on today's high-pressure, high-temperature steam generating equipment.

The highest degree of valve tightness is achieved with the Thermodisc Seat, an exclusive Consolidated feature. This unique seating design permits rapid equalization of temperature differentials set up when a high pressure valve reseats after blowing. The Thermodisc minimizes thermal stresses which cause seat distortion. Result: permanent tightness that saves on steam and valve maintenance.

The Consolidated "Maxiflow" is designed to function with a minimum blowdown. Blowdown adjustment can be made with the valve under full pressure.

Bulletin 707B contains complete details about Consolidated "Maxiflow" Safety Valves. Write for a copy.

MANNING MAXWELL & MOORE INC. TRADE MARK

CONSOLIDATED SAFETY VALVES

A product of

MANNING, MAXWELL & MOORE, INC.

Valve Division • Stratford, Connecticut

Canada: Manning, Maxwell & Moore of Canada, Ltd., Galt, Ontario
Latin America: Export Division, Chrysler Building, New York, N. Y.
Europe: Manning, Maxwell & Moore, S. A., Fribourg, Switzerland

For more facts circle 274 on Reader Service card, p 103

SPECIAL INTRODUCTORY OFFER

Take ANY ONE $1.00 for only

VALUES UP TO $20.00

To NEW MEMBERS of the Mechanical Engineers' Book Club

Product Engineering Design Manual. Edited by D. Greenwood. Save time and work in engineering design of components, devices, and products with this practical manual.
Publisher's Price, $10.00
Club Price $8.50

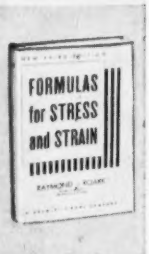
Handbook of Fastening and Joining of Metal Parts by V. Laughner, and A. Hargan. Quick answers to fastening and joining problems.
Publishers' Price, $20.00
Club Price, $16.95

Estimating Machining Costs by C. Parsons. How to make accurate and profit-supporting estimates of machining costs.
Publisher's Price, $8.00
Club Price, $6.80

The New American Machinist's Handbook. Edited by R. Le Grand. 1579 pages of dependable facts to speed up and simplify your work in shop and drafting room.
Publisher's Price, $15.00
Club Price, $12.75

Management for Engineers by R. Helmer. Aid your engineering future with these practical management methods.
Publisher's Price, $6.95
Club Price, $5.90

Mechanism by J. Beggs. Tested methods of analyzing complex mechanisms and solving mechanical design problems.
Publisher's Price, $8.50
Club Price, $7.25



Formulas for Stress and Strain by R. Roark. 3rd Ed. Brings together formulas, facts, and tables pertaining to strength of materials.
Publisher's Price, $8.25
Club Price, $6.95

Epoxy Resins: Their Applications and Technology by H. Lee and K. Neville. How to select and apply epoxy resins.
Publisher's Price, $8.00
Club Price, $6.80

How to Become a Professional Engineer by J. Constance. Helps you get your professional engineer's license more easily and quickly.
Publisher's Price, $5.50
Club Price, $4.70

Successful Technical Writing by T. Hicks. Step-by-step methods and practical pointers on writing for today's major technical markets.
Publisher's Price, $5.50
Club Price, $4.70

MAIL COUPON AT RIGHT TODAY

How many of these books do you wish you had at Club savings?

Select one for JUST A DOLLAR! Choose from *Handbook of Fastening and Joining of Metal Parts, Management for Engineers, The New American Machinist's Handbook,* and seven other valuable books . . . your introduction to membership in *The Mechanical Engineers' Book Club.*

If you're missing out on important technical literature—if today's high cost of reading curbs the growth of your library—here's the solution to your problem. *The Mechanical Engineers' Book Club was organized for you,* to provide an economical technical reading program that cannot fail to be of value to you.

All books are chosen by qualified editors and consultants. Their thoroughgoing understanding of the standards and values of the literature in your field guarantees the authoritativeness of the selections.

HOW THE CLUB OPERATES

Every second month you receive free of charge *The Mechanical Engineers' Book Bulletin* (issued six times a year). This gives complete advance notice of the next main selection, as well as a number of alternate selections. If you want the main selection you do nothing; the book will be mailed to you. If you want an alternate selection . . . or if you want no book at all for that two-month period . . . notify the Club by returning the convenient postpaid card enclosed with each *Bulletin.*

SAVES YOU MONEY AND THE BOTHER OF SHOPPING

We ask you to agree only to the purchase of three books in a year. Certainly out of the large number of books in your field offered in any twelve months there will be at least three you would buy anyway. By joining the Club you save yourself the bother of searching and shopping, and save in cost about 15 per cent from publishers' prices.

Send no money now. Just indicate any two books you want—one for only $1.00 and one as your first Club selection—in the coupon below. Take advantage of this offer *now,* and get two books for less than the regular price of one.

THIS COUPON WORTH UP TO $19.00

The MECHANICAL ENGINEERS' BOOK CLUB, Dept. P-5
327 West 41st Street, New York 36, N. Y.

Please enroll me as a member of the Mechanical Engineers' Book Club. I am to receive the two books I have indicated below. You will bill me for my first selection at the special club price and $1 for my new membership book, plus a few additional cents for delivery costs. (The Club assumes this charge on prepaid orders.) Forthcoming selections will be described to me in advance and I may decline any book. I need take only 3 selections or alternates in 12 months of membership. **(This offer good in U.S. only.)**

Show 2 numbers: #1 for dollar book and #2 for Club selection

- ___ Product Engineering Design Manual, $8.50
- ___ Handbook of Fastening and Joining of Metal Parts, $16.95
- ___ Estimating Maching Costs, $6.80
- ___ The New American Machinist's Handbook, $12.75
- ___ Management for Engineers, $5.90
- ___ Mechanism, $7.25
- ___ Formulas for Stress and Strain, $6.95
- ___ Epoxy Resins, $6.80
- ___ How to Become A Professional Engineer, $4.70
- ___ Successful Technical Writing, $4.70

PLEASE PRINT

Name .....

Address .....

City ..... Zone..... State.....

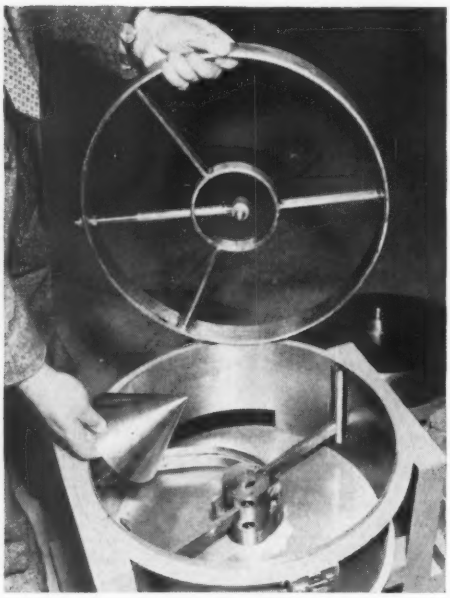
Company .....

NO RISK GUARANTEE If not completely satisfied, you may return your first shipment within 10 days and your membership will be canceled. P-5

For more facts circle 275 on Reader Service card, p 103

Plant equipment news . . . Your

For more data on these developments, circle key numbers on Reader Service card, p 103



Take the dust out of flyash

1 • Bulk-material conditioner treats flyash from collection equipment or any other finely divided material, making it dustfree and manageable, according to maker. Material flows continuously into the Verticone and is distributed in the form of a hollow cylinder. Inside the falling cylinder of material, a spray jet applies wetting agent uniformly to suppress dust. Three models handle 150 lb to 150 tons per hr.—The Johnson-March Corp

Combination starter designed for safety

2 • Double-door dead-front construction makes unauthorized entry a tough proposition. For maintenance, main door can be opened with a screwdriver—with disconnect switch or circuit breaker off. But another screw must be turned if disconnect or breaker is on. Once main door is open, you have to depress a defeater mechanism to turn breaker on. Operating handle can be padlocked off but not on. Components: Magnetic starter, control transformer and branch-circuit protective device.—General Electric Company

Cable-phasing test set is a labor-saver

3 • For reliable phase or conductor identification on underground cable systems, test set offers labor savings while keeping safety standards high. In the manhole, you connect all three conductors to ground after they have been exposed, clamp detector around each ground consecutively. Safety grounds ahead of work location are left in place. Pointer deflects in one direction for A phase, opposite for B, doesn't move for C. Dual-source transmitter operates from 60-c supply or dry cells.—James G Biddle Co

100-amp circuit breakers need less space

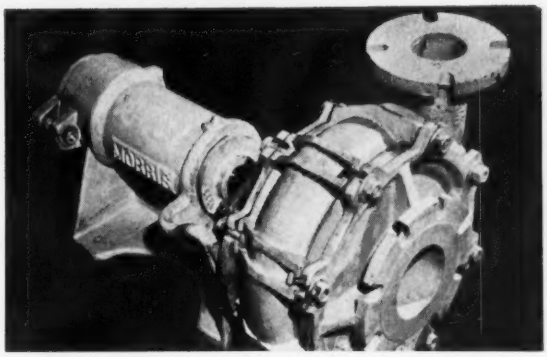
4 • Molded-case plug- or bolt-in breakers cut mounting-space requirements up to 2/3 for commercial or light industrial applications. Height: under 3 in. The 2-pole unit is 2-in., the 3-pole breaker 3-in. wide. Handles run full width of the breaker, spanning all its poles—extra gripping area for easy manual operation, and a sure guide during panelboard installation to tell which handle works which pole.—I-T-E Circuit Breaker Company

Gasket compound sets soft or hard

5 • Compound seals a variety of fluids and gases, working from −65 to +400 F, up to 5000 psi. Available as soft-set for connections needing periodic disassembly, hard-set for permanent installations, it's used for leakproofing, or to repair broken gaskets, build up damaged or warped flanged surfaces–or as a gasket substitute where surfaces permit.—Crane Packing Company

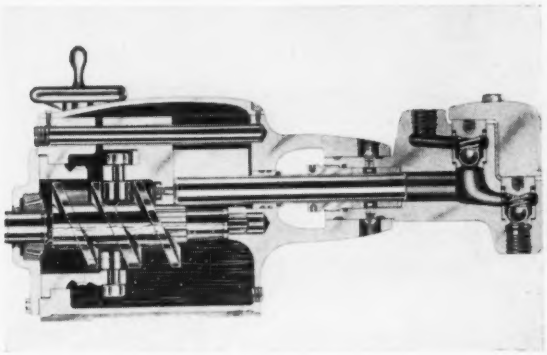
←Improved sheet packing at competitive price

6 • Tests and field experience qualify this standard asbestos-synthetic-rubber packing as a multipurpose material, formerly available only in premium grades. It has tested out (simulated conditions) sealing steam, water, oils, gases, hydrocarbons. Photo shows style 340 as a 2-ft flange gasket.—Keasbey & Mattison Co



Slurry pump nears clear-water efficiency

7 • Approximating efficiencies of clear-water units, JC process-industry pumps cope with both abrasive and corrosive slurries. Design shoots for low costs, easy maintenance, reliability. Standardized-component line has 11 models from 1 to 4 in.—Morris Machine Works



Adjust capacity with pump in action

8 • Series-300 proportioning pump lets you adjust capacity while pump is running. Control mechanism combines output of two cams to vary stroke, zero to maximum. Simplex model features capacities from 1 to 812 gph, duplex, 2 to 1624 gph.—American Meter Co

Bidirectional ball valves, sized from 1/4 to 2 in., offer varying design features

9 • Quick and easy installation is this valve's feature. Built-in union ends let you get the job done in just two steps: (1) screw or weld union ends to pipe ends (2) assemble 1-piece forged body to union nut. Valve disassembles equally fast for maintenance. Materials: stainless, carbon steel or brass.—Clayton Mark & Co

10 • Compact bar-stock valves with NPT or AND threaded ends are rated 600 wog, 1000-psi test. Materials of construction are carbon steel, 303 and 316 stainless or brass. Self-lapping and -cleaning action promises good sealing, long life, says maker. Prices start at $10.20 for the carbon-steel ¼-incher.—Hydromatics, Inc

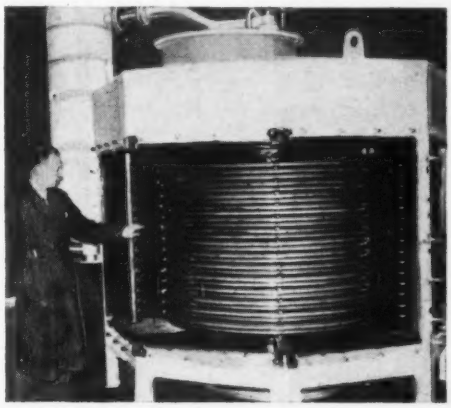
11 • Talking point here: disassembly on line. A tapered cartridge with bottom entry contains entire seating assembly, can be removed easily without taking valve body off the line. In bronze, steel or 316-stainless construction, it's rated from vacuum to 800 psi, —40 to +400 F. Handle is plastic-insulated.—Crane Company

Thrift-minded boiler operates on waste heat

12 • Designed to use exhaust heat from diesel engines, heating furnaces and gas turbines, boiler comes in standard sizes from 1100 to 6100 lb of steam per hr—larger models to order.

Efficient heating-coil design ups efficiency 10% over conventional, maker claims. Heart of the system is a series of helical tube coils in parallel rows. Inlet and outlet ends connect to distributing and collecting headers, headers attach in series to a steam drum or a boiler and circulating pump. Exhaust gas enters from below, passes radially over coils into casing, then out.

Sootblower cleans outside of heating coils and a hopper collects and discharges dirt. Circulating high-alkaline boiler water or acid cleaner takes care of inside deposits. Door panels allow coil inspection and removal—Pacific Overseas Machinery, Inc



For more data on these developments, circle key numbers on Reader Service card, p 103

SCAM

A Heritage of Quality

De-line TWINPOINT Annunciator

with new MAGNA-PLAC nameplates

Two complete alarm points in each cabinet position conserve panel area and reduce system cost.

- Nearly 5 sq. inches of engraving area for each point
- AO and AF sequences standard
- Conforms to regular De-Line construction features & quality
- All plug-in units are hermetically sealed

SCAM® INSTRUMENT CORP.

3101 N. Lowell Ave., Chicago 41, Ill.

Representatives in all principal cities

FOR MORE INFORMATION

sign and attach coupon to company letterhead.

NAME_____

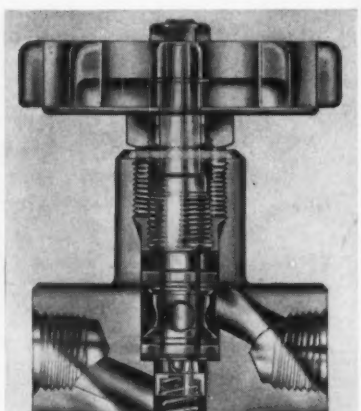
circle 276 on Reader Service card, p 103

Equipment news

Begins on page 118

H-p O-ring fittings

29 • O-ring seal type fittings promise leakproof service at 6000 psi with water, oil or gas. Unions need only hand tightening for good performance at temperatures from —20 to +275 F. Sizes: ¼ to 2½ in.—Kahn & Company, Inc



Shutoff valve handles liquid or gas at 6000 psi

22 • Made of stainless steel with Teflon seals, series 920-T valve withstands severe corrosive conditions. Internal design has Teflon packers for dead-tight seal. A floating sleeve rises to protect packers from flow when valve is open.

Seals can be replaced with valve on-line. Double-tapered stem design throttles gradually with valve closed. —Circle Seal Products Co, Inc

Just circle key numbers on the Reader Service card, page 103, to get complete product story

continued

How to return condensate a full mile at 280° F.

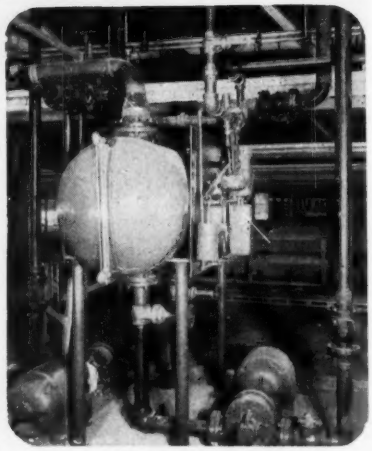


Photo courtesy of A. M. Byers Co., suppliers of the 4-D Wrought Iron pipe used on the return lines.

This is one of 11 Stickle differential boiler return systems at General Electric's famous Appliance Park in Louisville. For seven years, it's been pumping condensate back to a receiver tank in the boiler room at 270° to 280° F.—from heating and processing units as far as a mile away! The two pumps handle up to 150,000 lbs. of condensate per hour. Result: Tremendous savings in fuel and steam, plus top performance by all steam-using equipment.

If you use steam for processing or heating at pressures between 50 and 250 lbs., check with us. We can show you 8 ways to cut the cost of steam, increase production and improve quality . . . with a Stickle boiler return system.

• ASK FOR BULLETIN 250

STICKLE STEAM SPECIALTIES CO.

2265 Valley Ave. • Indianapolis 18, Ind.

Stickle Equipment

Cuts the cost of steam

FEEDWATER HEATERS • REGULATING AND REDUCING VALVES • DRAINAGE AND BOILER RETURN SYSTEMS • STEAM TRAPS • SINCE 1905

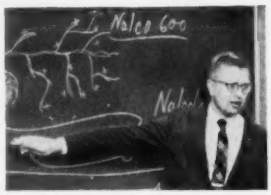
circle 277 on Reader Service card, p 103

A Nalco PRODUCT MANAGER

Discusses Nalco 600 Coagulant Uses, Economies and Characteristics

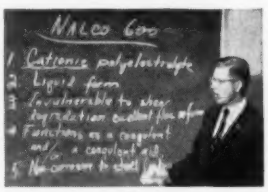
Cationic Polyelectrolyte Liquid is Non-Corrosive, Unaffected by Variable pH or Contaminants

Nalco 600, unlike most coagulants and coagulant aids, can be mixed thoroughly to insure full contact with turbidity particles without danger of shear degradation—the breaking up of coagulant molecules caused by agitation such as pumping, mixing and aeration. Thorough agitation actually improves Nalco 600 action in forming heavy, fast-settling floc!



". . . 600 is both a coagulant and a coagulant aid . . ."

Because of its cationic character, Nalco 600 is both a coagulant and a coagulant aid. It can be used alone to form floc, or it can be used with alum or sodium aluminate to bridge already-formed floc particles and give them added size and weight to speed settling. Whether Nalco 600 is used as a coagulant or as a coagulant aid depends on the water being treated, throughput rates, and many other conditions that your Nalco Representative can help you analyze to be sure of obtaining the best type of coagulant treatment for your particular requirements.


NALCO 600
1 Cationic polyelectrolyte
2 Liquid form
3 Invulnerable to shear degradation excellent floc reform
4 Functions as a coagulant and/or a coagulant aid
5 Non-corrosive to steel

". . . a non-corrosive, liquid coagulant . . . has many advantages . . ."

Dosage, feeding and handling of Nalco 600 are greatly simplified because of its liquid form—the *only* cationic polyelectrolyte coagulant chemical available as a liquid. Added to convenience of handling are 600's non-corrosive characteristics. Stable Nalco 600 can be stored in drums or ordinary steel tanks without worry about corrosion damage. Steel feeding equipment and piping are safe, too.

". . . pH fluctuations and organic contaminants do not impair 600 performance."

Most coagulation troubles in water systems are caused by organic contaminants entering the systems in varying amounts and upsetting the coagulation chemical dosage rates. This is another area of trouble-free operation with Nalco 600. It is not affected as much by organic contamination as other coagulant chemicals are—and it stays effective through wide pH fluctuations . . . unlike alum, where a delicate pH balance must be maintained to get proper flocculation and settling.

"Nalco 600 is a branched polymer which is very effective in forming extremely heavy floc," reports J. T. Burke, Manager, Nalco Coagulation Chemicals Department.

". . . no substitutes for effective chemicals, programmed by experts . . ."

Your Nalco Representative has both the chemicals and the skills to be genuinely helpful to you in getting coagulation results that maintain high clarification rates with sensible treatment economy. His application experience with the wide range of Nalco water treating chemicals is one of the important reasons Nalco has been able to take coagulation and clarification problems out of the realm of guesswork and put them on a sound, practical basis.

Call today for action from your Nalco Representative, or write for Nalco Process Bulletin A-1 for detailed information on Nalco coagulant chemistry.

NALCO CHEMICAL COMPANY

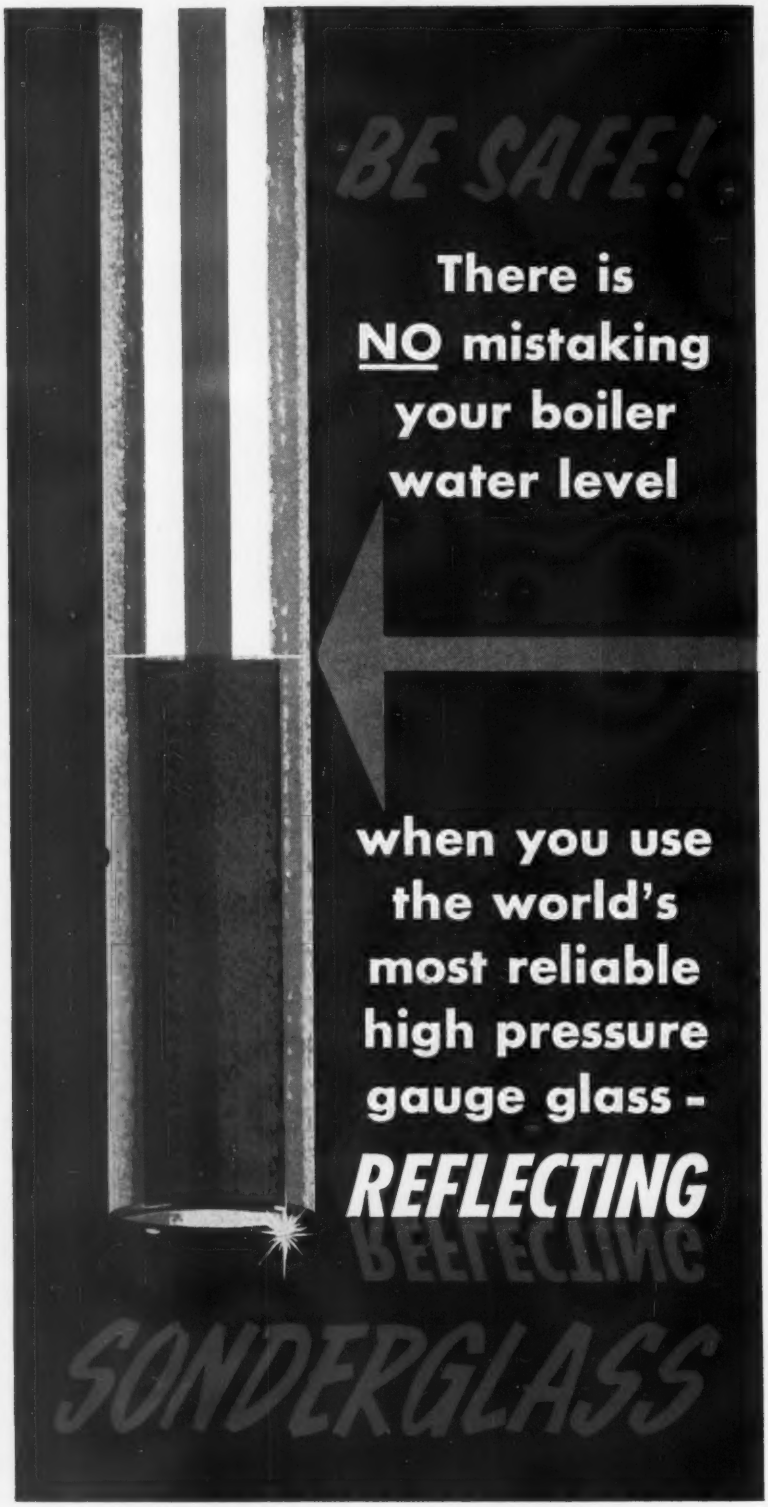
6222 West 66th Place • **Chicago 38, Illinois**

Subsidiaries in England, Italy, Mexico, Spain, Venezuela and West Germany
In Canada: Alchem Limited, Burlington, Ontario

Nalco® ... Serving Industry through Practical Applied Science

Nalco CHEMICALS
Nalco SERVICES
Nalco CHEMICALS
Nalco SERVICES
Nalco CHEMICALS
Nalco SERVICES
Nalco CHEMICALS
Nalco SERVICES
Nalco CHEMICALS
Nalco SERVICES
Nalco CHEMICALS
Nalco SERVICES
Nalco CHEMICALS
Nalco SERVICES
Nalco CHEMICALS
Nalco SERVICES
Nalco CHEMICALS
Nalco SERVICES
Nalco CHEMICALS
Nalco SERVICES
Nalco CHEMICALS
Nalco SERVICES
Nalco CHEMICALS
Nalco SERVICES
Nalco CHEMICALS
Nalco SERVICES
Nalco CHEMICALS
Nalco SERVICES
Nalco CHEMICALS
Nalco SERVICES

For more facts circle 278 on Reader Service card, p 103



Reflecting SONDERGLASS is the original magnifying redline gauge glass. Its fused double-layer construction resists alkali and acid, remaining clear and easy to read. SONDERGLASS has been tested to upward of 1,000 lbs., per sq. in. steam pressure and 4,000 lbs. hydraulic pressure. It has been subjected to 450° oil baths and repeatedly plunged into cold water without spalling or cracking. Provide your men and boilers with the **extra margin of safety** by using only SONDERGLASS. Sold by leading industrial distributors.

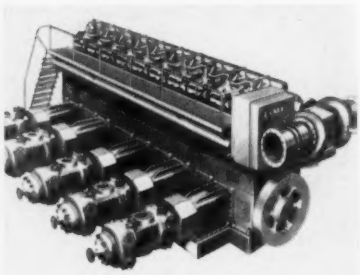
A. W. CHESTERTON CO., Everett 49, Massachusetts

Equipment news

Begins on page 11

Insulating oil features high flash point

62 • Universal oil features flash point 10-C higher than firm's previous transformer and circuit-breaker oils. 145-C flash point gives greater margin of safety. Compatible with previous oils, new oil has same uses. —Westinghouse Electric Corp



Compressor designed for 1500 to 3000 bhp

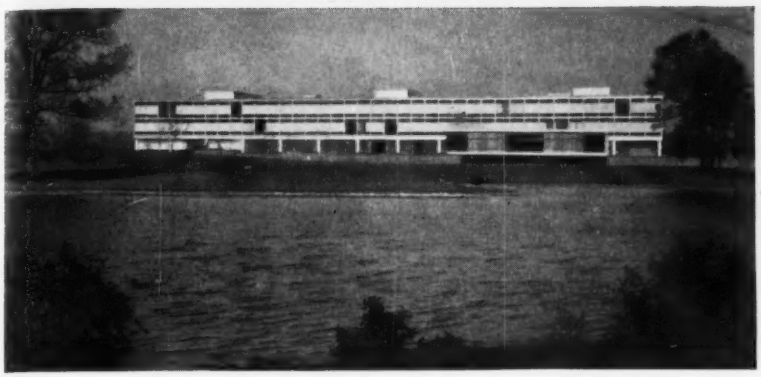
39 • Model TBA has 17x17-in. bore and stroke. These gas-engine compressors, in 5-, 6-, 8- and 10-power-cylinder models, will be rated 1500, 1800, 2400 and 3000 bhp. Components are designed with inherent stamina required for high turbocharging power, maker claims.—Clark Bros Co

Just circle key numbers on the Reader Service card, page 103, to get complete product story

New condenser-tube design slated to stretch life

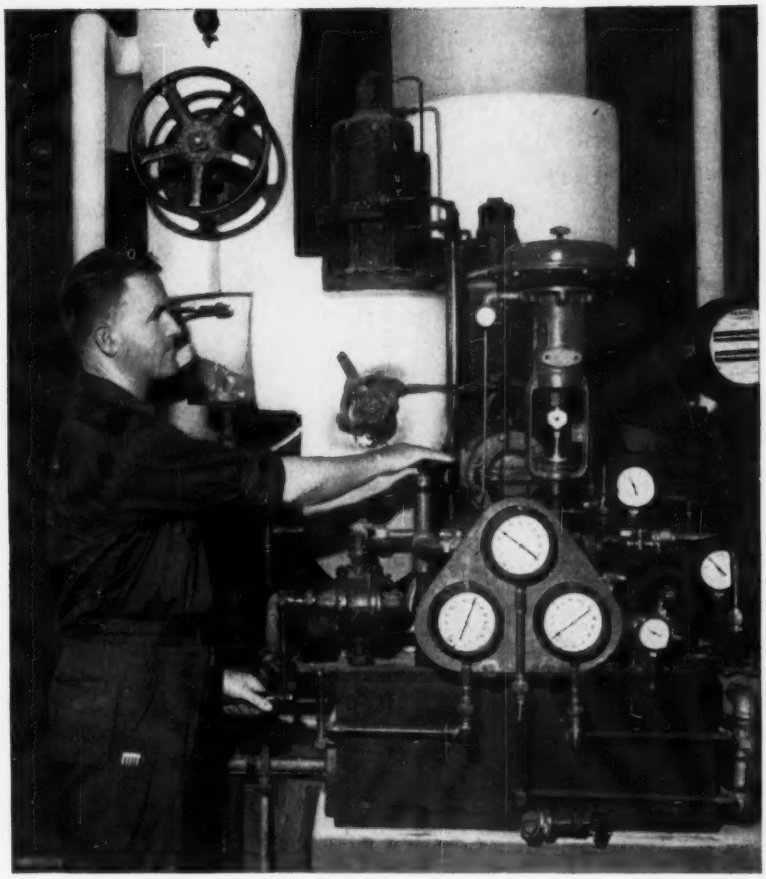
38 • Tapered end tubes combat inlet-end erosion, may cut premature tube failure. Erosion is a thinning attack often caused by the air or sand entrained in sea or harbor water—scouring action removes tubes' protective surface film.

Conventional remedy: thickened end tubes; but problem here was turbulence where the thickened part



New home office for Connecticut General Life is a modern structure five miles out in the country.

Terry turbines power air-conditioning system at new Connecticut General Life building



One of two 870-hp, 3970-rpm Terry turbines built to drive the refrigeration compressors.

The new home office of the Connecticut General Life Insurance Co., in suburban Hartford, represents the best in contemporary architecture as well as construction techniques and materials.

In keeping with the careful planning evident throughout the project, two Terry turbines were selected to drive the York centrifugal refrigeration compressors. Terry turbines such as these have a record of low maintenance and consistent reliability under varied conditions. The steam generators, which are used for general heating during the winter months, furnish the power to operate the turbines. This provides an economical and dependable air-conditioning setup.

The steel and glass building accommodating 2500 employees overlooks New England farmland. It is furnished with modern equipment, to step up the efficiency of clerical work. Other amenities: lounges, game rooms, cafeteria, bowling alleys, barber and beauty shops, variety store, medical department.

If you are planning an air-conditioning system, perhaps you, too, should consider steam-turbine drive. Write for detailed information about the advantages of turbines for your specific requirements.

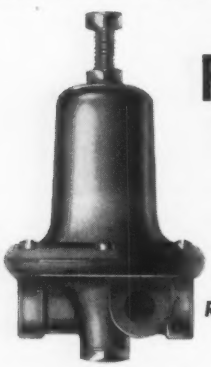
THE TERRY STEAM TURBINE CO.
TERRY SQUARE, HARTFORD 1, CONN.

TERRY

W-1213

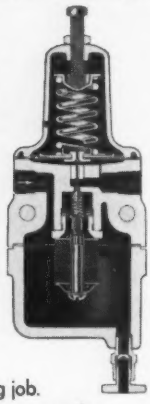
NO VIBRATION-NO CHATTER

With these low-cost multipurpose regulators



FISHER
Series
67

LOW VOLUME REGULATORS



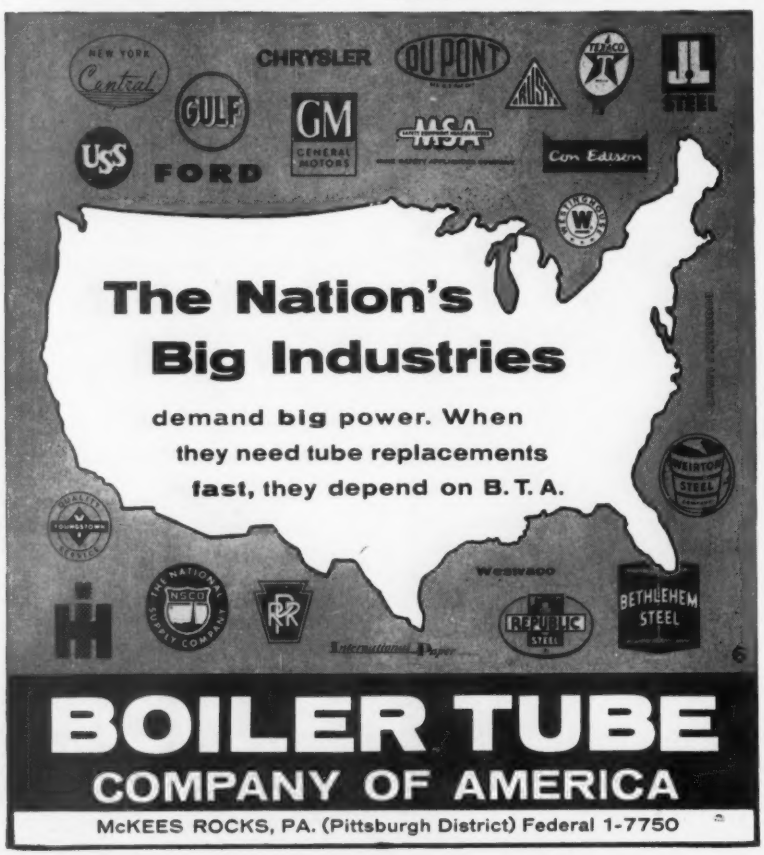
Here's a small valve that does a big job. It's particularly suitable as an auxiliary operating pressure regulator for air or gas service. Five spring ranges are available, 5 to 20 — 5 to 35 — 30 to 60 — 55 to 100 psi. Series 67 is also available with brass body for small volume water service. **Write for Bulletin C-67C.**

IF IT FLOWS THROUGH PIPE ANYWHERE IN THE WORLD . . .
CHANCES ARE IT'S CONTROLLED BY . . .

FISHER GOVERNOR COMPANY
Marshalltown, Iowa / Woodstock, Ontario / Rochester, England

FISHER® Controls

For more facts circle 281 on Reader Service card, p 103



BOILER TUBE COMPANY OF AMERICA

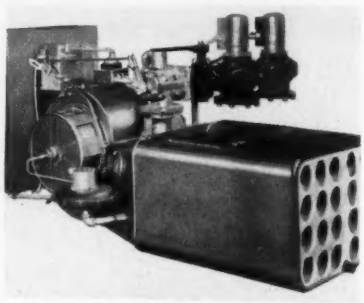
McKEES ROCKS, PA. (Pittsburgh District) Federal 1-7750

For more facts circle 282 on Reader Service card, p 103

Equipment news

Begins on page 118

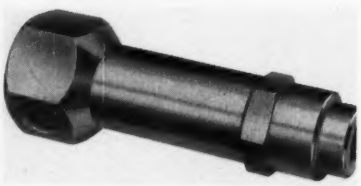
stopped. Tapered-end tubes, having no sudden termination, should alleviate pressure-drop problems.—Chase Brass & Copper Co



Gas burners use building-block design

35 • Automatic motorized mechanical-draft gas burners feature building-block component design. Standard interchangeable parts include 4 different valve-manifold assemblies, 7 control-cabinet arrangements, 3 optional oil assemblies for standby-fuel firing. Burners come in six sizes for capacities up to 35,000,000 Btu per hr.—Mettler Co, Inc

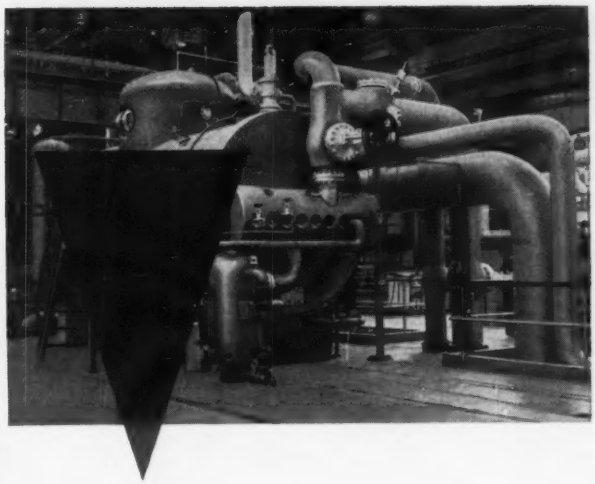
Just circle key numbers on the Reader Service card, page 103, to get complete product story



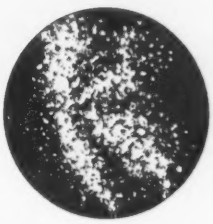
Relief valve works from 850 to 7200 psi

20 • Series-5300 valve is externally referenced for use as a priority or sequence valve. It operates from —40 to +200 F, provides dead-tight sealing to above 95% of preset cracking pressure, maker states.

There's almost no pressure rise with increasing flow—design permits



WHEN INDUSTRY NEEDS WATER



PURER THAN THE DRIVEN SNOW

Yuba Evaporators are achieving new record high purities

Other Yuba products for steam power plants include Condensers, Feedwater Heaters, Expansion Joints, Heaters, Tanks, Cranes, Structural Steel and scores of other items.

In power, processing, marine or any industry that needs high purity water in volume, Yuba evaporators are recognized as the finest equipment available today. There are good reasons why. Recent tests by Consolidated Edison Company of New York show that purities better than 0.004 PPM total solids are achieved – purities "heretofore unknown." Heart of the Yuba evaporator is the patented improved bubble tray design. Yuba evaporators have reached their present peak because of continuous refinement of design, engineering and manufacturing. And Yuba's mechanical vapor purifier has also been found to be the most efficient of its type within the limits of mechanical purifier design.

Bubble tray or mechanical evaporators, Yuba designs are the most flexible in the industry. They can be installed vertically or horizontally—in a wide capacity range – depending on the industry need or basic plant design. Whatever your high purity water need, remember Yuba for the finest in evaporators. Write today for the complete story of tests on Yuba equipment – Bulletin YHT 101.

YUBA

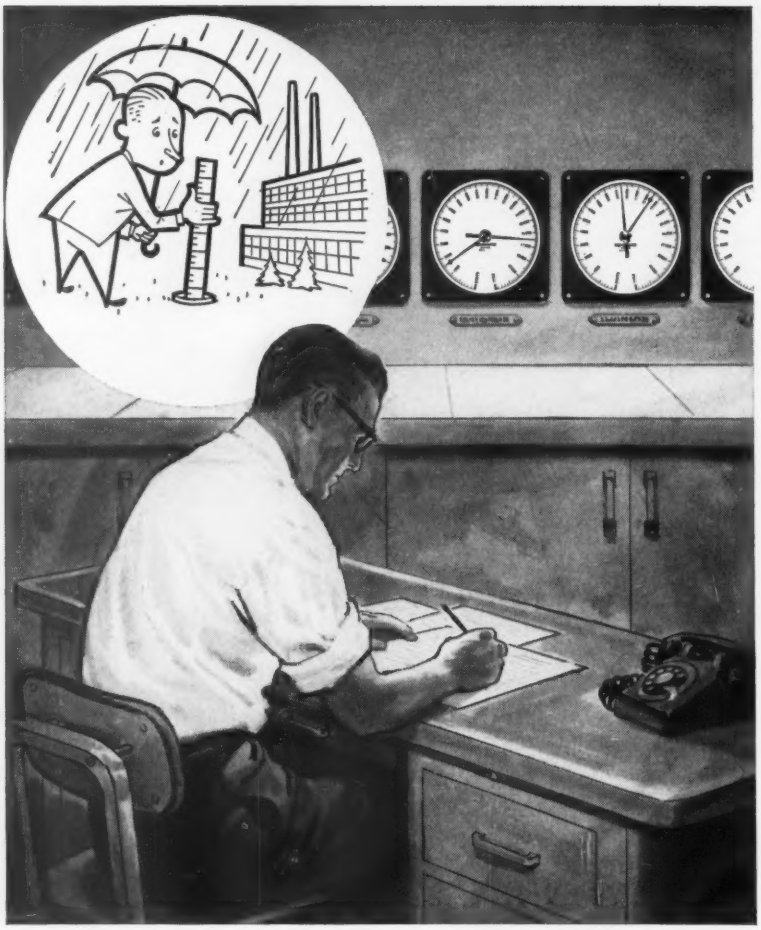
specialists in power plant equipment

YUBA HEAT TRANSFER DIVISION

YUBA CONSOLIDATED INDUSTRIES, INC.

SALES OFFICES IN PRINCIPAL CITIES

For more facts circle 290 on Reader Service card, p 103



Take the legwork out of liquid measurement

Here's practical liquid measuring—the modern way... without roaming all over the lot! Liquidometer Gauges let you inventory distantly stored liquids at a glance.

Completely automatic Liquidometer Gauges can be located as far as 250 feet from tanks. Think what this centralized system can mean in man-hours saved—let alone the additional safety of personnel who no longer have to trudge to, or tamper with, hard-to-get-at tanks.

Simple to install, and requiring no maintenance, Liquidometer Gauges measure virtually all liquids conveniently, continuously, and correctly. There's a type available for practically every liquid measuring application.

For complete details, write

LIQUIDOMETER INSTRUMENTS

THE LIQUIDOMETER CORP.

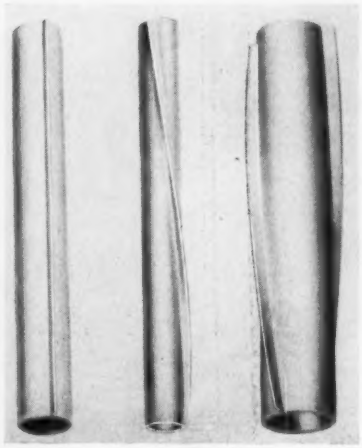
Dept. R, LONG ISLAND CITY 1, NEW YORK

For more facts circle 283 on Reader Service card, p 103

Equipment news

Begins on page 118

system backpressure on poppet to increase its life, give good flow characteristics. Balanced design is said to cut chatter and squeal.—Circle Seal Products Co, Inc



Finned tubing for nuclear reactors

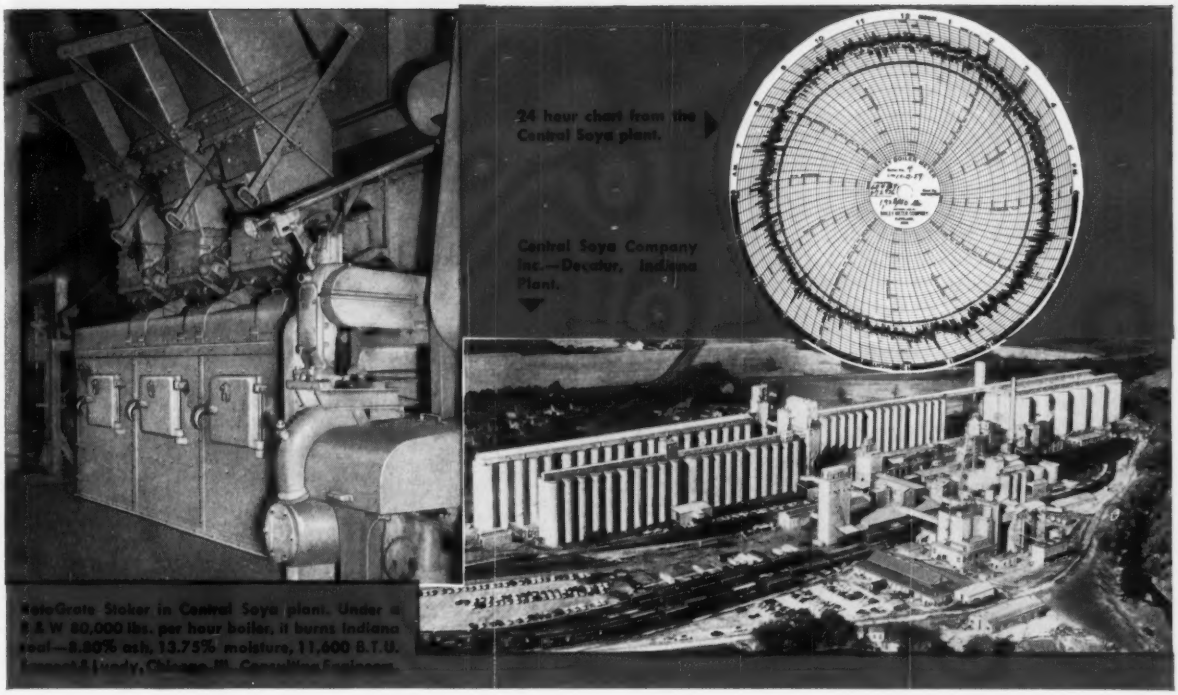
23 • Straight and spiral integral-finned tubing manufactured by precision cold-finishing methods is now available from Superior Tube. Tubing is used for nuclear fuel elements and heat exchangers. It's made in austenitic stainless steels, nickel and nickel alloys, reactive metals including titanium and Zircaloy.

Finned tubing has extended surface for improved heat transfer, rigidity. Integral fin is currently supplied in straight and spiral types on outside surface of tube—up to eight fins per tube.—Superior Tube Company

Just circle key numbers on the Reader Service card, page 103, to get complete product story

Weld fittings

32 • Socket-weld tube fittings are available in aluminum, brass, Inconel, nickel, stainless steel and steel. Standard line comes in sizes from 1/8- to 1-in. OD. Custom shapes, sizes and materials can be made up to your specs. Fittings are designed to tackle problems of corrosion, pressure and



RotoGrate Stoker in Central Soya plant. Under a B & W 80,000 lbs. per hour boiler, it burns Indiana coal—8.80% ash, 13.75% moisture, 11,600 B.T.U. Sargent & Lundy, Chicago, Ill., Consulting Engineers.

8 Years of Stoker Operation
Without Forced Outage

DETROIT ROTOGRATE AVAILABILITY AT CENTRAL SOYA COMPANY INC.

Hersel Nash, Steam Power Superintendent of Central Soya Company, Inc., Decatur, Indiana Plant says: "Our 80,000 pounds per hour, 600 psig boiler with Detroit RotoGrate Stoker has carried loads similar to the accompanying chart for 355 days per year for eight years (we have the boiler down for inspection and cleaning once each year, for about 10 days.)"

"During this time we have burned about 300,000 tons of Indiana coal without ever losing the load because of the stoker. Our monthly efficiencies average 85% to 86%. This is above the manufacturer's predicted performance."

This 'round the clock—seven days a week operation year in and year out with high economy proves the rugged stamina and ability of the RotoGrate . . . shows why it has long been first choice among operators and top management alike.

Built to serve steam generators up to approximately 400,000 pounds steam per hour capacity, the RotoGrate is one in a complete line of Detroit Stokers . . . overthrow spreader and underfeed types for commercial, industrial and utility boiler plants—also for incineration of both municipal and industrial wastes.

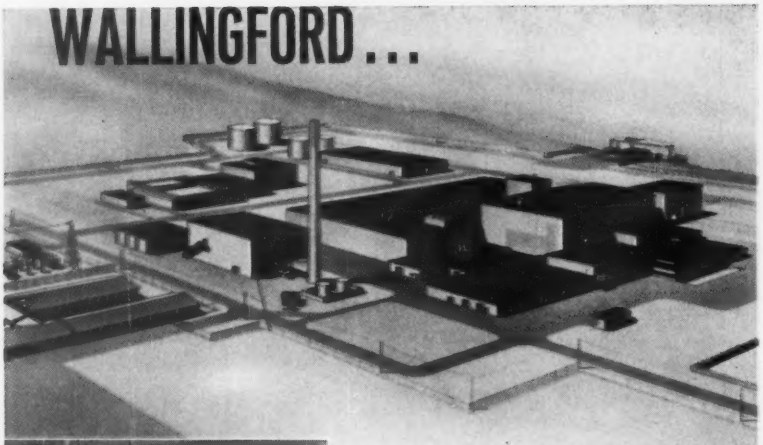
DETROIT STOKERS COST LESS Cost equals initial investment plus upkeep, plus production losses due to equipment outage. *The total is less with Detroit.* Ask for Bulletin.

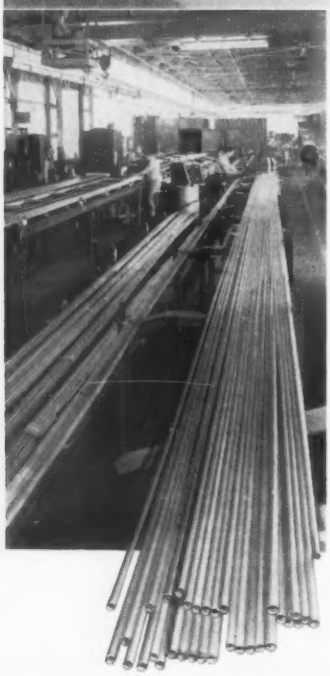
DETROIT SINCE 1898 STOKERS

DETROIT STOKER COMPANY
DIVISION OF UNITED INDUSTRIAL CORPORATION
MAIN OFFICE AND WORKS • MONROE, MICHIGAN
District Offices or Representatives in Principal Cities

For more facts circle 284 on Reader Service card, p 103

WALLINGFORD...





PRODUCES 1,000,000 FLAWLESS FEET TO TRAP ENERGY-GENERATING HEAT

...an energy conversion system made as it must be with WALLINGFORD

Stainless Steel

At the Atomic Energy Commission's Hanford Works plutonium-making plant, Richland, Washington, one million feet of welded stainless steel tubing will perform a tremendous money-saving function under critical radioactive conditions . . . by helping ten steam generating units built by Combustion Engineering to trap energy-generating heat otherwise destined to be wasted.

The Wallingford Steel Company produced the miles of reliable, corrosion resistant, high quality tubing needed on this specific heat conversion job!

To meet rigid Atomic Energy Commission specifications, the tubing had to satisfy uncommonly strict demands for ideal physical and metallurgical properties . . . for an ability to withstand extreme pressures . . . for exceptional tensile and yield strengths . . . and for flare and bend qualities.

Exclusive Wallingford fabricating and testing techniques ensured the tubing's total perfection. These same techniques are what makes Wallingford stainless advantageously different. Ask our customers "Why Wallingford?" And ask us for specific recommendations on your need for stainless steel tubing or strip.

Progress in Metals Since 1922

THE WALLINGFORD STEEL CO.

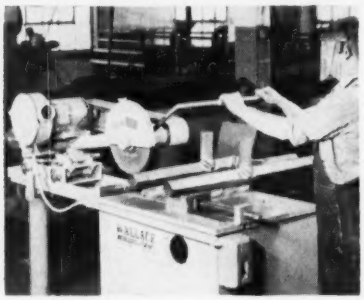
TONNAGE *on a Laboratory Basis*

WALLINGFORD, CONNECTICUT, U.S.A.

Equipment news

Begins on page 118

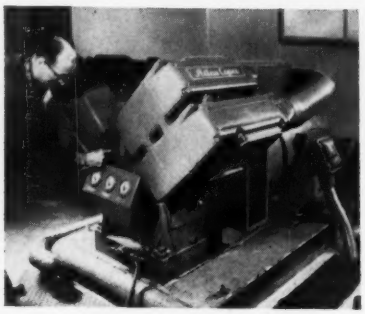
temperature, turn in a leakproof performance even under vibration and shock conditions, according to maker. —Cajon Machine Company



Machine cuts clean

27 • Surface finishes finer than 100 rms are common with this machine. It cuts an 8-in. steel I-beam in less than 18 sec, costs well under $2000. Plates, too, can be handled—unit will cut through a 3x24-in. plate in about 4 min. It also cuts aluminum, brass, copper, most plastics.—Wallace Supplies Mfg Co

Just circle key numbers on the Reader Service card, page 103, to get complete product story



Heavy-duty air compressor delivers 565 cu ft per min

36 • This 100-hp stationary heavy-duty compressor is designed for 'round-the-clock operation. It delivers from 509 to 565 cu ft of air per min at pressures up to 125 psi. Features,

SOLVE THESE NINE KEY WATER HANDLING PROBLEMS IN YOUR POWER PLANT WITH PEERLESS PUMPS

PEERLESS PUMP apply these proven-in-use pumps to cover a broad range of services in circulating, boosting, draining and transfer applications...

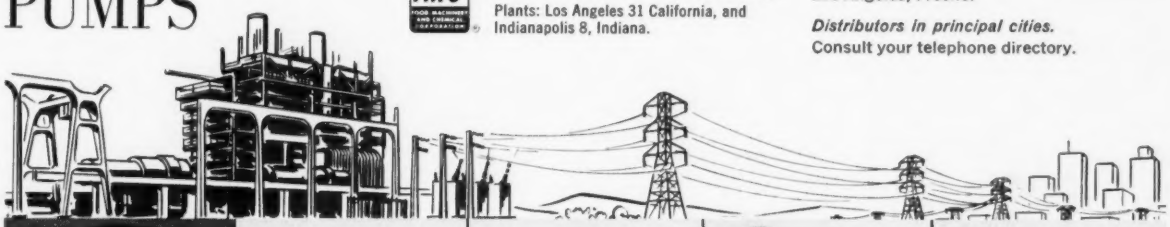
Producing power calls for equipment that can meet the rigors of continuous day-in, day-out performance. It calls for top performing pumps teamed with maximum engineering stamina.

It's a standard that Peerless meets and beats with ease. Small wonder then that Peerless equipment is selected in job after job. But Peerless offers you another added plus—careful, conscientious field engineering service. It's there when you want it, and it is there to help you in planning the best practical methods for handling the various pumping jobs you have. Here's another point to consider. The Peerless line is a complete one. Select your needs from pumps ranging from small fractional horsepower models to giant units capable of moving up to 220,000 gpm. Check the pumps listed below and request your copies of the bulletin you wish sent to you. Write Peerless Pump, Hydrodynamics Division, Food Machinery and Chemical Corporation at 301 West Avenue 26, Los Angeles 31, California, or 2005 Northwestern Avenue, Indianapolis 8, Indiana.

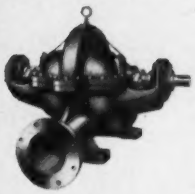
Putting Ideas to Work
PEERLESS PUMP
HYDRODYNAMICS DIVISION
Plants: Los Angeles 31 California, and Indianapolis 8, Indiana.

Offices: New York; Detroit; Chicago; Cleveland; Indianapolis; St. Louis; San Francisco; Atlanta; Plainview; Lubbock; Phoenix; Albuquerque; Los Angeles; Fresno.

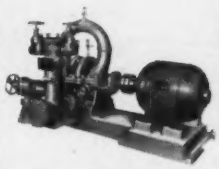
Distributors in principal cities.
Consult your telephone directory.



PEERLESS PUMP
GET THE JOB DONE



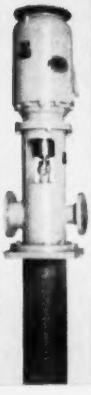
BOOSTER, CIRCULATING SERVICE
Horizontal Split Case Peerless TYPE A offers widest possible application in water pumping. Broad range of capacities and heads. Request Bulletin B-1300.



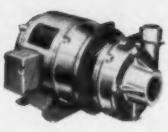
FIRE PREVENTION AND CONTROL
Select from vertical and horizontal FIRE PUMP models. All models are approved by Underwriters Lab and Associated Factory Mutual Fire Insurance Companies. Request Bulletin B-1500.

CONDENSER CIRCULATING SERVICE
Close Coupled HYDRO-FOIL pumps can be installed for wet or dry pit application. Extremely adaptable where space is limited. Request Bulletin B-148.

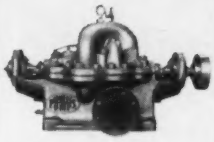
COOLING TOWER SERVICE
The Peerless lineup of VERTICAL INDUSTRIAL SERVICE pumps are extremely efficient, require little maintenance. Install them inside or outside. Request Bulletin B-505.



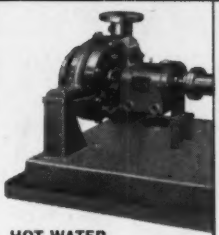
HEATER DRAIN, CONDENSATE RETURN SERVICE
Peerless HYDRO-LINE® pumps handle fluids up to 400°F. Will operate with any available NPSH. Request Bulletin B-1700.



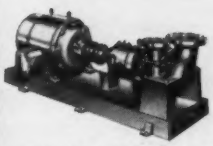
IN-PLANT CHILLED WATER PUMPS
End suction centrifugal FLUIDYNE® pumps are highly versatile in application, extremely efficient in service, and economical to operate. Models in all desired sizes. Request Bulletin B-2300.



EVAPORATOR FEED, BOILER WASH, HEATER DRAIN
Peerless TU and TUT pumps have internal or loop cross-over. Multi-stage design allow pumps to develop high head and capacity from a compact unit. Request Bulletin B-1400.



HOT WATER, TRANSFER CHEMICAL FEED
Select from a comprehensive line of Peerless TYPE DM AND DMR pumps. Unsurpassed for handling superheated water and chemical fluids. Request Bulletins B-1608, B-1610.

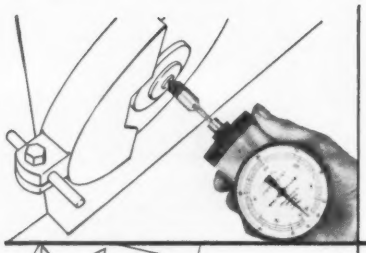


BOILER LANCERS, HEATER DRAIN
A heavy duty, packing gland type pump, the Peerless TYPE PR is specially designed for heavy pumping assignments. Handles hot or cold liquids with equal efficiency. Request Bulletin B-1605.

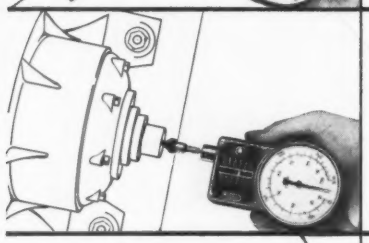
Check Speeds with a

BIDDLE Tachometer

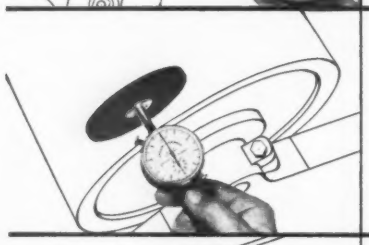
and be sure!



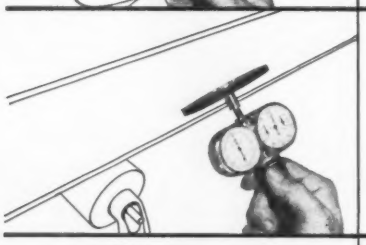
a **JAGABI® Centrifugal TACHOMETER** reads instantaneous speeds or variations in speeds up to 48,000 RPM. Single or multiple ranges.



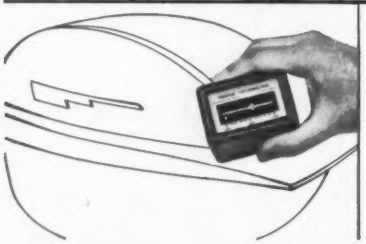
DR. HORN TACHOMETER is a centrifugal type instrument with 6 ranges for checking speeds from 25 to 30,000 RPM.



JAGABI® Chronometric SPEED INDICATOR measures *average* speeds. Available in ranges from 100 to 100,000 RPM.



the **JAGABI® TACHOSCOPE**—a stop watch and revolution counter in one—gives average FPM and RPM up to 20,000.



FRAHM® Resonant Reed TACHOMETER checks speeds *at a touch.* Requires no contact with moving parts—reads directly in RPM.

There's a Biddle Hand Tachometer precision-engineered for every speed measuring need . . . each complete with *all* accessories and carrying case, as required . . . and all backed by Biddle Reliable Repair Service. To help you select the Biddle instrument best for you, write for BULLETIN 35P.

B106

BIDDLE INSTRUMENTS

JAMES G. BIDDLE CO.

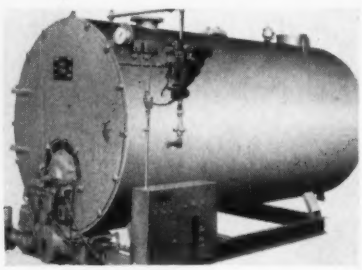
Electrical & Speed Measuring Instruments

1316 ARCH STREET • PHILADELPHIA 7, PA.

Equipment news

according to manufacturer: low first cost, running economy, long life.

The DT4 is a short-stroke 2-stage double-acting fully air-cooled unit. It's intended for stationary operation, but can be mounted on bonded rubber, made semiportable—useful where normal concrete foundations aren't practical.—Atlas Copco



Packaged boilers fire gas, oil or combination

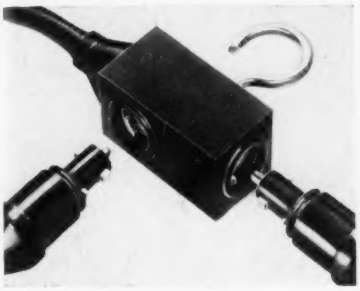
33 • These 3-pass packaged units feature controlled air-atomized firing. Valve control system and dual pump and reservoir are said to deliver constant fuel supply at any oil temperature or viscosity. Enclosed control cabinet holds operating and programing flame-safeguard controls and circuit breakers.—Ray Oil Burner Co

Just circle key numbers on the Reader Service card, page 103, to get complete product story

Teflon seal ring has spring expander

30 • Teflon's main drawback as a sealing material is lack of resilience. This manufacturer puts an internal expander in the Teflon seal ring to maintain a continuous mechanical force against the sealing surface. Stainless steel or synthetic rubber expander is used, depending on service conditions. Rings need no adjustment; sizes range from ⅛- to 15-in. ID.—Tanner Engineering Co

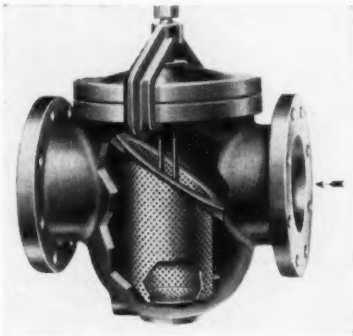
Begins on page 118



Explosionproof plugs safe for hazardous areas

40 • Explosionproof plugs and receptacles permit safe, rapid connections for electric lighting and power distribution. They can be used with 2-, 3- or 4-wire circuits rated up to 240 v, 15 amp or 120 v, 30 amp. Electrical-grade copper contacts are encased in neoprene bodies.

Design prevents possibility of a spark igniting an explosive atmosphere. Lip on plug fits into a collar on receptacle to form a sealed chamber. Only then can plug be turned to complete circuit.—J B Nottingham & Company, Inc



Basket strainers protect pumps, valves, regulators

26 • Four low-cost basket strainers can go in steam, air, oil, gas or chemical lines. They'll catch dirt, foreign matter and pipe cuttings in most suction, high- or low-pressure installations. Units come in semisteel or cast steel with clamped or bolted covers. Sizes: 2 to 16 in.—Strong

Quiet, Efficient, Convenient

Ideal for Hospitals, Hotels, Apartments, and Industries where noise is objectionable.

Rotojet Electric Tube Cleaner thoroughly cleans straight tubes from 25/32" to 4" I.D. in boilers, condensers, evaporators, and heat exchangers so quietly that it can be operated without disturbing anyone.

This self-contained unit comprises a powerful motor, rotatably mounted on a stand, a required length of heavy duty flexible shaft, a 20 ft. cable, and a selection of heads, brushes, drills, and scrapers to meet any cleaning need. The motor swivels and rotates so that tubes on top, bottom, and sides can be cleaned without moving the unit. A few of the many types of heads available are shown below.

Bulletin 107 gives full details of this quiet, efficient, convenient tube cleaner. Send for it now.

Rotojet Electric Tube Cleaner with swing-frame head.

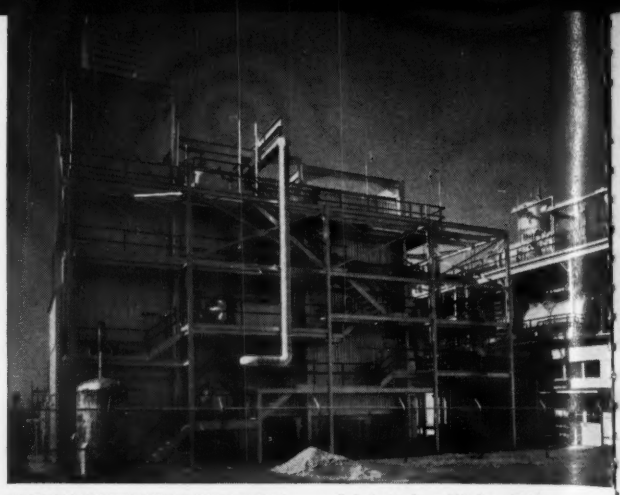
4-way drill and universal coupling.

Expanding wire brush.

ELLIOTT COMPANY – ROTO PLANT
Tube Cleaner Specialists Since 1910
1071-53 Bristol Road. Mountainside, N. J.

For more facts circle 288 on Reader Service card, p 103

Power for Texas by way of Michigan with



REPUBLIC ELECTRUNITE BOILER TUBES were fabricated at Wickes Boiler Company in Saginaw, Michigan, shipped to Bryan, Texas, for power plant installation. Strict ELECTRUNITE tolerances and production control provided precise fit at job site.

REPUBLIC ELECTRUNITE BOILER TUBES

When Wickes Boiler Company cuts and bends boiler tubing in Saginaw, Michigan, for installation in a Bryan, Texas, power plant, there is no room for error—every unit must fit perfectly into place.

Wickes specified ELECTRUNITE Boiler Tubing for the job because of its consistently close tolerances in tube thickness, roundness, concentricity, and ductility.

The Bryan power plant, with a continuous capacity of 200,000 pounds per hour at 1,000 psi, utilizes ELECTRUNITE for super heater elements and water wells.

Exclusive ELECTRUNITE manufacturing process is universally accepted by leading technical authorities, code societies, boiler and heat exchanger manufacturers, Federal and State committees, and boiler insurance requirements.

Get the complete facts on ELECTRUNITE for boiler, heat exchanger, condenser, or evaporator tubing. Call your Republic representative, or write direct.

FARROWTEST REJECT TABLE

Wall Thickness (B.W. Gage)	Minor dimension of the defect (Length or Depth)	Defective Area (Length, Depth Plane)
20	.006"	.0025 sq. inches
18	.006"	.003 sq. inches
16	12½% of wall	.003 sq. inches
14 and 13	12½% of wall	.004 sq. inches
12 and heavier	12½% of wall	.005 sq. inches

FARROWTEST detects and rejects not only tubing containing defects which completely penetrate the wall; but also tubing with defects equal to, or greater than, those shown in this table. For irregular defect shapes, a tube with defect area equal to or greater than shown above is rejectable. Where required, sensitivity of FARROWTEST equipment can be calibrated to reject defects of lesser specified area than shown in table, at extra cost.

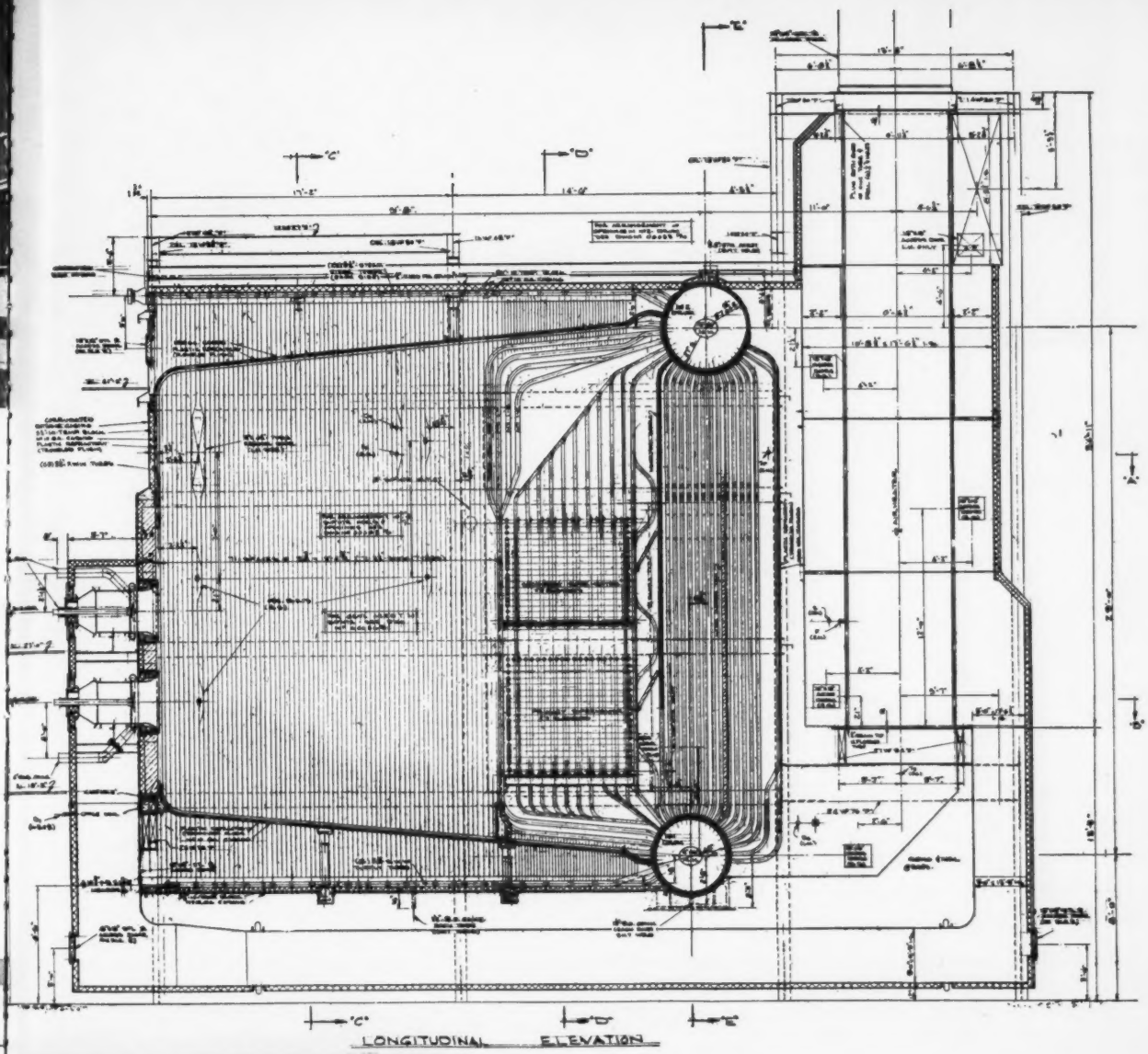
FARROWTEST—QUALITY YOU CAN MEASURE. Not a laboratory theory, not a mere inspection tool, but an exclusive production test that detects and rejects tubing containing defects of critical size. FARROWTEST is offered as an alternative to other less positive tests in accordance with the table above, at no extra cost.

Steel Strong, Modern, Dependable

REPUBLIC STEEL

REPUBLIC HAS THE FEEL FOR MODERN STEEL

For more facts circle 289 on Reader Service card, p 103



UNIFORM DUCTILITY, TROUBLE-FREE BENDING AND STRETCHING are assured with Republic ELECTRUNITE Boiler Tubes. Exclusive process ELECTRically-UNITEs the tube under pressure without additional metal. Only highest quality flat-rolled open-hearth steel is used.

TYPE "RB" BOILER—WICKES BOILER COMPANY

Boiler heating surface	18,690 sq. ft.
Waterwall heating surface	6,720 sq. ft.
Air heater heating surface	31,800 sq. ft.
Maximum continuous capacity	220,000 lb./hr.
Design pressure	1,000 psi
Operating pressure	875 psi
Total steam temperature	900°F.

REPUBLIC STEEL CORPORATION
DEPT. A-2156
221 EAST 131st STREET • CLEVELAND 8, OHIO

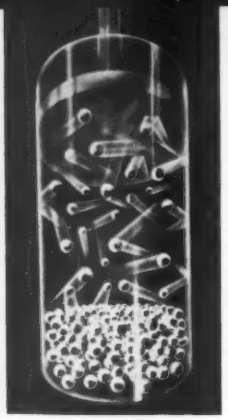
Please send more information on the following products:
☐ Republic ELECTRUNITE® Boiler Tubes
☐ FARROWTEST®

Name_____ Title_____

Firm_____

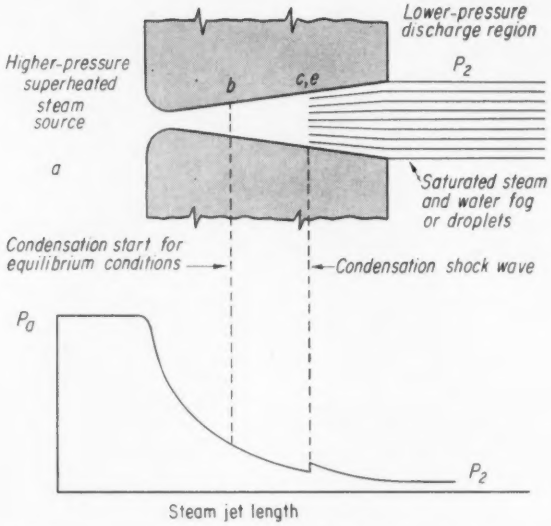
Address_____

City_____ Zone____ State_____



THERMO REFRESHER NO. 49

By B G A SKROTZKI,
Associate Editor



1 When steam passing through a nozzle enters its saturation state it becomes supersaturated before condensation shock

Now that we have looked at overall steam cycles we'll study some of the components and see how they work. Let's start with simple . . .

Steam nozzles and diffusers

The steam turbine, heart of the steam cycle, converts internal energy of the working fluid into mechanical shaft work. In Parts 28 through 31 (POWER, June through September 1959) we studied the functions of the nozzles and buckets of gas turbines.

Action of the working fluid in passing through buckets or blades of turbines is the same whether the working fluid is gas or vapor — so we won't go any further into these processes for steam turbines. But we run into some interesting actions when steam changes phase in flowing through a nozzle. It will pay us to study nozzle steam flow and its peculiarities.

Supersaturation. When steam enters and leaves a nozzle in superheated states it acts pretty much like a gas. We can use either the steam tables or $PV^n=C$ to figure the change in states and flows, (Part 28, June 1959). But when superheated steam flowing through a nozzle exhausts in a wet state we find that it does not act smoothly.

In Fig. 1, superheated steam enters a nozzle at pressure P_a and exhausts at P_2. As it flows through the nozzle we can measure its static pressure. Assuming a constant-entropy expansion we can figure its state for each pressure, Fig. 2 at top of next page.

Such a calculation shows that at section b of the nozzle, Fig. 1, the steam should start condensing. But instead it remains a vapor until section c,e when it suddenly starts condensing and forms an entrained fog or mist made up of saturated-water droplets. This plane is a condensation shock—a standing shock wave (Part 29, July 1959). Studying the expansion process on T-S and H-S charts, Fig. 2, shows some interesting actions. As the static temperature drops along the constant-entropy expansion below b the actual static pressure is higher than the corresponding saturation pressure. At the condensation shock c, actual static temperature is T_c but actual static pressure is P_e instead of the lower saturation pressure P_c corresponding to T_c. As the steam passes through the shock wave its static temperature and pressure rises to state e at corresponding saturation temperature and pressure T_e and P_e.

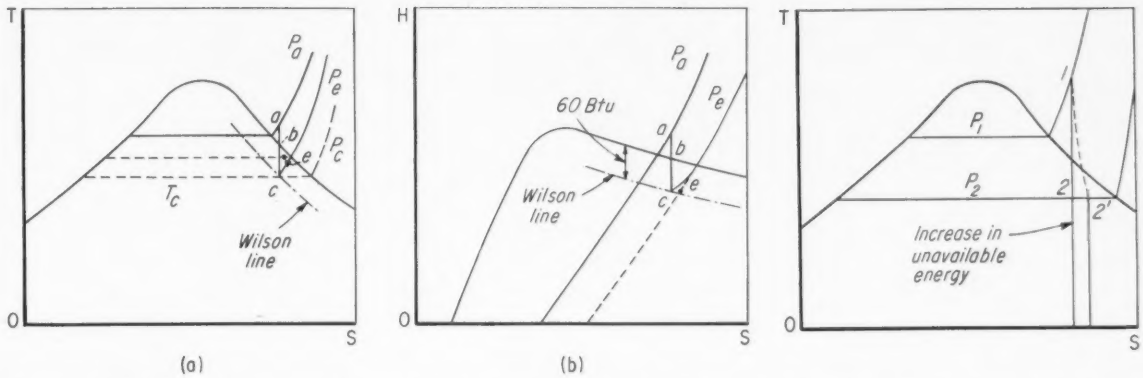
Between states b and c the steam is in the *supersaturated* or *metastable* state. If the steam passed through all corresponding saturated pressures and temperatures while it expanded it would be in *equilibrium*. Degree of supersaturation is measured by the so-called *supersaturation ratio* P_e/P_c.

C T R Wilson discovered this behavior in 1897 while experimenting with mixtures of air and water vapor. He found that air free of dust but saturated with water vapor could be expanded by 25% in volume before the vapor condensed to a fog—that is, 25% more than the specific volume corresponding to saturation.

Flow of condensing steam was studied by John Yellott and others during 1934 to 1937. They found that condensation shocks formed on the Mollier and T-S charts at a curve that was about 60 Btu below the saturated vapor locus; this is the Wilson line.

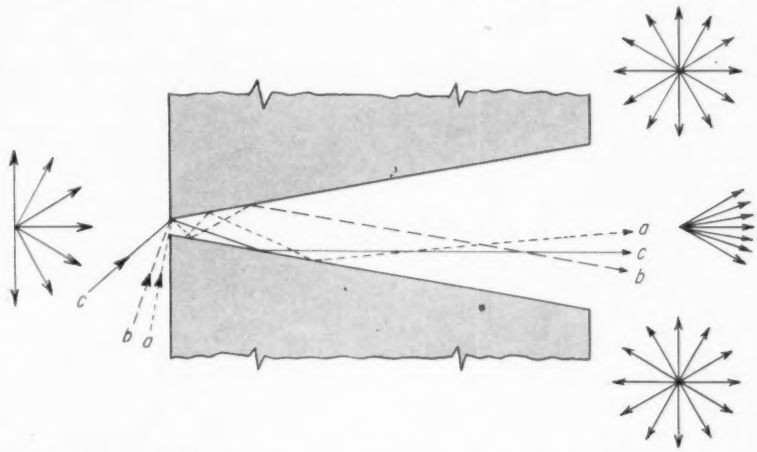
As Fig. 1 shows, static pressure jumps as the jet passes through the condensation shock wave. Liquid drops expanding beyond the shock probably stay hotter than the vapor, which cools rapidly with further expansion until it reaches the exhaust pressure. This is a *2-phase flow* with the saturated-steam molecules moving faster than the saturated-water molecules. The steam jet probably does not reach equilibrium until it is well out of the exit section of the nozzle.

Molecular action. To maintain equilibrium conditions we would slowly expand steam trapped in a



2 Steam expanding into the saturation region from *a* becomes supercooled at *c* though its actual pressure is P_c. After condensation shock, temperature rises to T_e at *e*

4 Irreversibility of steam flow in nozzle increases the unavailable energy



3 Diverging part of nozzle reflects molecules of steam into axial path and makes the static pressure drop. Exhaust-region molecules tend to backflow into steam jet

cylinder by a piston. As we expand the volume by letting the steam do work adiabatically on the piston, all molecules of the steam move in all directions with a wide variety of speeds (Maxwell distribution, Part 6, Feb 1957.) They slow down as they do work on the piston and their helter-skelter directions and speeds make them collide billions of times a second with their neighbors. The slower ones, when colliding, quickly coagulate into drops of saturated water.

We have different conditions for flow through a nozzle as in Fig. 1 and 3. Even for small pressure differences across a nozzle, steam jets acquire a high speed. But more significantly the jet is made up of steam molecules traveling essentially in the same common direction. For a diverging nozzle, Fig. 3, we see that the initial random directions of molecules entering the nozzle are rearranged to move almost axially out of the nozzle exit. Paths *a*, *b* and *c* show how the flared nozzle walls do this, assuming individual lone molecules travel without interference and have equal angles of impact and rebound from the walls.

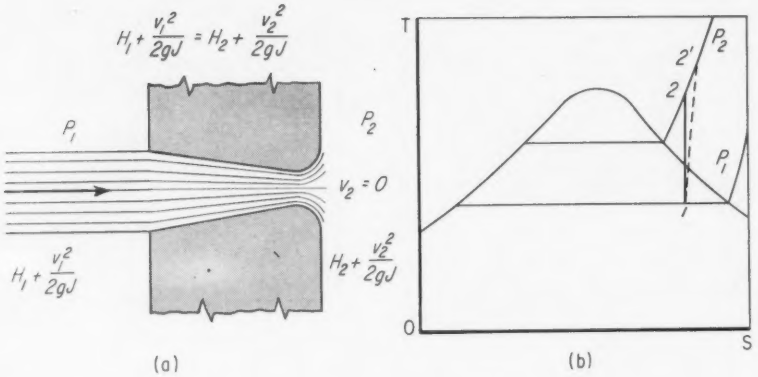
Trillions of molecules streaming through the nozzle continuously jostle each other but the walls have the same aligning effect. The half star of vectors at the nozzle entrance shows the range of molecular direction and average speed of the entering molecules. The narrow fan of vectors at the exit shows the comparable direction and speed range of the molecules leaving the nozzle. Drop in static pressure along the nozzle indicates fewer collisions of molecules with the walls and with each other because of the aligning effect.

With fewer collisions it becomes more difficult for the slower molecules to meet and coagulate into drops of water. The steam becomes supersaturated. Then, what causes the condensation shock wave? It might be the backflow effect of the exhaust-region molecules where the leaving jet is surrounded by vapor molecules traveling in all directions. These act on the jet and probably generate a backflow element of molecules in the jet that are effective up to the condensation shock wave.

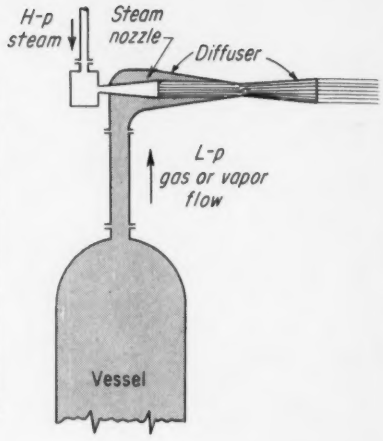
At the shock wave, momentum of the advancing jet molecules probably balances momentum of the backflow molecules so they have no effect further upstream. Backflow molecules at the shock wave produce a mixing effect, so slower molecules in the jet can now meet more easily to form water drops. This is pure speculation, not bolstered by mathematical analysis, but it does seem plausible.

Nozzle performance. Like all thermodynamic machines, nozzles do not perform perfectly despite their simplicity. They convert the random motion of the molecules (internal energy) of the working fluid into an organized motion of a jet that we measure as kinetic energy of the body of fluid. In one sense the latter is also internal energy since a thermometer can translate this into stagnation temperature, ideally the same as source temperature (Part 28, June 1959).

Steam flowing through the nozzle is retarded by friction with the wall of the nozzle. This irreversible effect returns energy to the steam jet at the expense of decreasing the kinetic energy gained by the jet. Actually there is a slight loss of heat by radiation but this is usually assumed negligible, so the expansion is considered adia-



5 Diffuser acts as a reversed nozzle, takes high-speed steam jet from low-pressure region, slows it up by converting kinetic to internal energy at higher pressure



6 Steam ejector uses h-p steam to build vacuum in vessel by removing all gases

batic. Straight nozzles will usually have fewer losses than curved ones; larger nozzles usually perform better than smaller ones.

From the steady-flow energy equation for a nozzle:

$$H_1 + \frac{v_1^2}{2gJ} = H_2 + \frac{v_2^2}{2gJ} \qquad (1)$$

$$H_o = H_2 + \frac{v_2^2}{2gJ} \qquad (2)$$

$$v_2 = \sqrt{2gJ\ (H_o - H_2)} \qquad (3)$$

where H_o is the stagnation enthalpy of the steam entering the nozzle. If the entering velocity $v_1 = 0$, then $H_o = H_1$ and $P_o = P_1$.

Ideal leaving velocity v_2 depends on a constant-entropy expansion from state *1* to state *2* as in Fig. 4. Actual leaving velocity $v_{2'}$ will be lower because actual state *2'* will have a higher enthalpy $H_{2'}$ than H_2. The irreversible flow will increase the unavailable energy by the amount of the rectangular area under *2-2'* in Fig. 4.

Nozzle performance is measured by nozzle efficiency defined as:

$$e_N = \frac{v_{2'}^2/2gJ}{v_2^2/2gJ} = \frac{H_o - H_{2'}}{H_o - H_2} \qquad (4)$$

That is, it's the ratio of actual to ideal leaving kinetic energies. Another measure of nozzle performance is the nozzle velocity coefficient, defined as:

$$C_v = \frac{v_{2'}}{v_2} = \frac{\sqrt{2gJ\ (H_o - H_{2'})}}{\sqrt{2gJ\ (H_o - H_2)}} = \sqrt{e_N} \qquad (5)$$

This simply becomes the square root of the nozzle efficiency.

Another measure of nozzle performance is the coefficient of discharge, defined as:

$$C_d = \frac{\textit{Actual mass flow rate}}{\textit{Ideal mass flow rate}} \qquad (6)$$

This would be figured from tables or property formulas and known and ideal end states of the expansion process. It can vary from about 0.9 to over unity for supersaturated conditions.

Diffusers. A reversed nozzle is called a *diffuser*, Fig. 5. Diffuser takes in a high-speed jet of steam or gas at a relatively lower pressure, slows it down and discharges the flow to a higher-pressure region at a lower velocity, usually near zero. In other words, the diffuser is a pump or compressor without an impeller. Usually the diffuser works at less efficiency than a pump or compressor. Advantage of the diffuser lies in its simplicity. As a static device with no moving parts it is usually much less expensive.

Steady-flow energy equation for a diffuser is the same as the nozzle when using subscripts *1* and 2 for initial and final states, equation (1). But now the initial velocity is of major importance and the final velocity of little importance since it's usually near zero. We need to know final enthalpy H_2 that can be developed for a given initial enthalpy H_1 and velocity v_1. By transposing equation (1) we get:

$$H_2 = H_1 + \frac{1}{2gJ}(v_1^2 - v_2^2) \qquad (7)$$

If v_2 is negligible this reduces to:

$$H_2 = H_1 + \frac{v_1^2}{2gJ} \qquad (8)$$

Diffuser performance. Often we want to deliver working fluid from a lower to a higher pressure. Ideally this would be as a constant-entropy compression from *1* to *2* as in Fig. 5*b*. But because of frictional irreversibilities the entropy increases during the process and we find the fluid must be delivered at a higher temperature (and enthalpy) at the same pressure P_2. For an actual diffuser, then:

$$H_{2'} = H_1 + \frac{v_{1'}^2}{2gJ} \qquad (9)$$

Since H_1 is the same for the ideal and actual compression and $H_{2'}$ is larger than H_2, it follows that the actual initial velocity $v_{1'}$ must be higher than the ideal v_1. We have to use more kinetic energy initially than we would in the ideal diffuser to make the actual diffuser work.

Diffuser efficiency may be defined as:

$$e_D = \frac{H_2 - H_1}{H_{2'} - H_1} \qquad (10)$$

assuming that final velocity at higher pressure $v_2 = 0$. If this is not so, then H_2 and $H_{2'}$ should be the stagnation enthalpies for the two states.

Diffuser application, Fig. 6, is most common in ejectors, low-cost

circle 291 on Reader Service card, p 103 ➤

FOR EXACTING SERVICE WHITEY* CONTROL VALVES

for 1/8 through 1/2" O.D. Tubing feature usual and unusual metals with Swagelok Tube Fitting Connections

• MONEL • HASTELLOY B • INCONEL • BRASS • 316 S.S.

For years, WHITEY RESEARCH TOOL CO. has used exceptional machining and engineering skill to produce valves in new alloys that most manufacturers hesitate to machine. Monel, Hastelloy, Inconel and Nickel require top skill. It is through this manufacturing skill that quality performance is combined with quality appearance to provide precision, leak-tight WHITEY Valves to meet your most exacting system requirements.

WHITEY Valves are available in straight and angle pattern styles with 1/8" through 1/2" SWAGELOK Tube Fitting connections or 1/8" through 1/2" male and female pipe connections.

Panel mounting; Teflon* cylinder packing; micro-regulating and non-regulating stems are standard features on all WHITEY Valves. Colored handles, to permit color coding, can be specified when ordering.

Pressure ratings of WHITEY Valves range from 3,000 p.s.i. to 5,000 p.s.i. All WHITEY Valves are available with SWAGELOK Tube Fitting connections for efficient, leakproof installation.

COMPLETE TECHNICAL DATA ON *WHITEY* VALVES AVAILABLE ON REQUEST.

*Dupont Trademark

WHITEY RESEARCH TOOL CO.
5525 MARSHALL STREET
OAKLAND 8, CALIFORNIA

WHITEY* TM*

Stack specialists agree:

A. O. Smith glass-protected stacks are dollar sound... last up to 3 to 5 times longer than unlined steel stacks

You get more for the dollar because A. O. Smith glass-protected smokestacks are sound as a dollar:

- **Glass is tough, durable**—shows remarkable resistance to impact or abrasion
- **They last longer** — as much as 3 to 5 times longer than unlined steel stacks — corrosion-resistant regardless of excess condensate
- **Maintenance is low!** There's no painting — glass can't rust
- **Economical to install** — no need for special equipment or highly skilled workmen.

Through research ...a better way

A.O.Smith CORPORATION

SMOKESTACK SALES
ATOMIC & PROCESS EQUIPMENT DIVISION
P.O. Box 584, Milwaukee 1, Wis.

Now available in 8 harmonizing colors • Write for new 4-color bulletin No. 210

For more facts circle 292 on Reader Service card, p 103

ROBVON BACKING RINGS

ROBVON BACKING RINGS APPROVED FOR WELDING PIPE, VALVES AND FITTING JOINTS

Robvon's Commercial Backing Rings are designed for quick easy alignment of pipe or tubing and assure precise close tolerance fit-up. Robvon Backing Rings allow complete penetration and fusion of the weld. Robvon Backing Rings radiograph perfect certified welds. The patented nubs automatically set the welding gap for the root-pass. The internal bevel and flat inner land assures non-restricted fluid flow.

ROBVON BACKING RING COMPANY 675 Garden Street, Elizabeth, N. J.

Reg. Pat. Nos. 2,764,426 & 2,366,379

Phone: EL. 2-9613

Thermo refresher

Begins on page 134

pumps for removing gases and vapors from low-pressure spaces. Here the steam jet is formed in a converging-diverging nozzle, the steam being supplied by a line. Steam jet is aimed into a converging-diverging section, like a venturi tube, which is the diffuser.

The vessel has gases or vapors to be removed so its pressure may be kept low. These expand to fill the vessel and the pipeline connecting to the diffuser. Gases or vapors get entrained in the fast-moving steam jet and are carried through the diffuser to a higher-pressure region, usually the atmosphere. As the gases and vapors are removed from the diffuser entrance, more of them flow up from the vessel by expansion; a continuous removal or purging process.

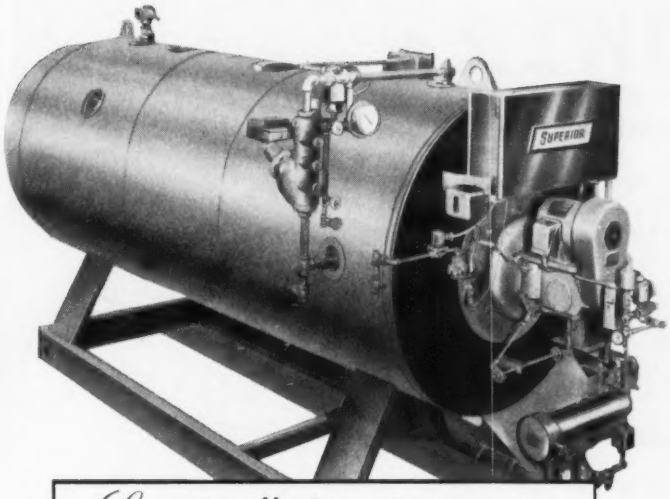
Another form of this application: water injection into small boilers. Here, Fig. 6, we substitute a feedwater line for the vessel and connecting pipe. Steam nozzle and diffuser are usually much smaller physically for water injection than gas removal. But the water gets entrained in the steam jet and is pumped or carried into the boiler drum at a higher pressure than initial feedwater pressure to the injector.

Next month we study the thermodynamics of steam engines.

$9,000,000 thermal power plant will go up in Dover, Delaware. McKee Run Electric Station, scheduled for operation in early 1962, will generate an initial 33,000 kw with future capability of 143,000 kw.

"I wasn't joking—I said, call the plumber!"

Don't settle for less than SUPERIOR®



Specify all these features now and avoid wishing you had later

when YOU buy a boiler

Because boilers are generally purchased or specified by executives acting for their corporations, or consulting engineers who are acting for their clients; the men who buy boilers seldom sign the checks which pay for them.

To these men, upon whom falls the responsibility of spending someone else's money, Superior's many engineered features make the purchase of a boiler a sound investment.

1 Complete Package — Unit Responsibility

If you settle for less, you may find yourself playing that old army game known as "passing the buck".

2 Shipped Complete after Fire-Testing

The tests of a prototype won't prove the performance of YOUR unit . . . and factory-fire-testing "gets the bugs out" at the factory . . . not in your boiler room.

3 More than 80% Thermal Efficiency

You'll be pleasantly reminded of its efficiency and operating economy every time you pay a fuel bill.

4 Full 5 Sq. Ft. of Heating Surface per Bhp.

Ample heating surface combined with 4-pass design produces those high efficiencies without strain.

5 Integrated Induced Draft

It's quieter. It's safer. It's cleaner. Instead of forcing soot into your boiler room, it sucks it out.

6 Simple Installation is Economical

Requires no tall expensive chimney, no special foundation other than a floor which will support its weight.

7 Heavy-duty, Rugged Construction

Check its weight. It's heavier . . . built for that long-lived operation which generates owner satisfaction.

8 Built to fire Oil, Gas, or Both

Designed for any liquid or gaseous fuel, and supplied with burners and controls to suit your own operations.

9 Ideal for Battery Operation

Where load demand fluctuates widely, battery installations provide wide flexibility at maximum operating economy.

For condensed data describing the World's Most Complete Line of Packaged Boilers, write today for Catalog S 11

Fire-Tube and Water-Tube PACKAGED BOILERS

for STEAM or HOT WATER

SUPERIOR COMBUSTION INDUSTRIES INC.

TIMES TOWER, TIMES SQUARE, NEW YORK 36, N. Y.

SUPERIOR PACKAGED BOILERS®

A New Concept of Marketing Service!

POWER's

"Directory of Manufacturer's Agents Serving the Power Field"

(1961 Edition)

Contains important information from more than 2000 agents and representatives throughout the United States, Canada and the world. Lists products handled, manufacturers represented, and much more.

FOR THE FIRST TIME—Regional editions make this service more useful!

If you're an agent, use to expand or get new lines.

Manufacturers can use to round out representation, broaden sales outlets.

ORDER NOW—immediate shipment. Regional editions, each $5.50. Complete edition $15.00.

EASTERN

Maine
New Hampshire
Vermont
Massachusetts
Rhode Island
Connecticut
New York
New Jersey
Pennsylvania
Delaware
Maryland
District of Columbia
Virginia
West Virginia
North Carolina
South Carolina
Georgia
Florida
Kentucky
Tennessee
Alabama
Mississippi

MIDWESTERN

Ohio
Indiana
Illinois
Michigan
Wisconsin
Minnesota
Iowa
Missouri
North Dakota
South Dakota
Nebraska
Kansas

WESTERN

Arkansas
Louisiana
Oklahoma
Texas
Montana
Idaho
Wyoming
Colorado
New Mexico
Arizona
Utah
Nevada
Alaska
Washington
Oregon
California
Hawaii

CANADA & OVERSEAS

Argentina
Australia
Austria
Belgium
Canada
Chile
Cuba
Denmark
Egypt
England
Finland
France
Germany
Greece
Guatemala
Iceland
Ireland
Italy
Japan
Luxemburg
Mexico
Puerto Rico
Scotland
Sweden
South Africa
Uruguay
Venezuela

POWER
330 West 42nd Street
New York 36, N. Y.

Please send me POWER's Directory of Manufacturers' Agents in the edition checked below. ☐ I enclose $_____. ☐ Bill me for $_____.

Eastern $5.50 **Western $5.50** **Canada & Overseas $5.50**
Midwestern $5.50 **Complete $15.00**

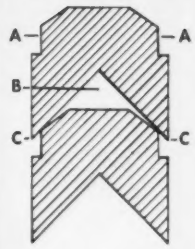
Name_____

Address_____

City_____ Zone_____ State_____

circle 296 on Reader Service card, p 103 ➤

GREATER ECONOMY
PERFECT SEALING
LONGER LIFE



A Recessed wall reduces contact area and friction.

B Reservoir for liquid being packed against.

C Sealing lips.

"PRECISION FORMED" for Sealing Perfection Liquid "trapped" in angular spaces between rings forces lips outward for a perfect seal — lubricates rod or plunger for minimum drag.

Install Heavy Duty AMFLEX* Packing Rings
The Perfect Seal for Hydraulic Rods and Plungers

Here's a heavy duty packing ring, with nearly square cross section—*yet it's sensitive to the pressure of a finger-tight gland!* Inconceivable? Not when these unique design features are known:

Amflex—a sturdy ring designed especially for deep stuffing boxes—incorporates a special construction used in other type Anchor packing rings. Liquid "reservoirs" between the rings hold the packing lips against the plunger with just the right pressure for a tight seal—*at all times and automatically*—while lubricating the plunger to reduce drag and wear to a minimum!

No need to experiment—specify Amflex for that heavy duty application and be sure... proved in performance to outlast others—designed to provide the perfect seal. Amflex Packing Rings are durable and efficient in all high pressure and low pressure applications involving oil, solvents, water and steam.

For complete specifications on Amflex, or other Anchor products, see your Anchor Representative today, or contact the Anchor General Office in Philadelphia.

*Specifically designed for deep stuffing boxes, where high pressures are encountered.

Find It Fast in The "Yellow Pages"

DISTRICT OFFICES

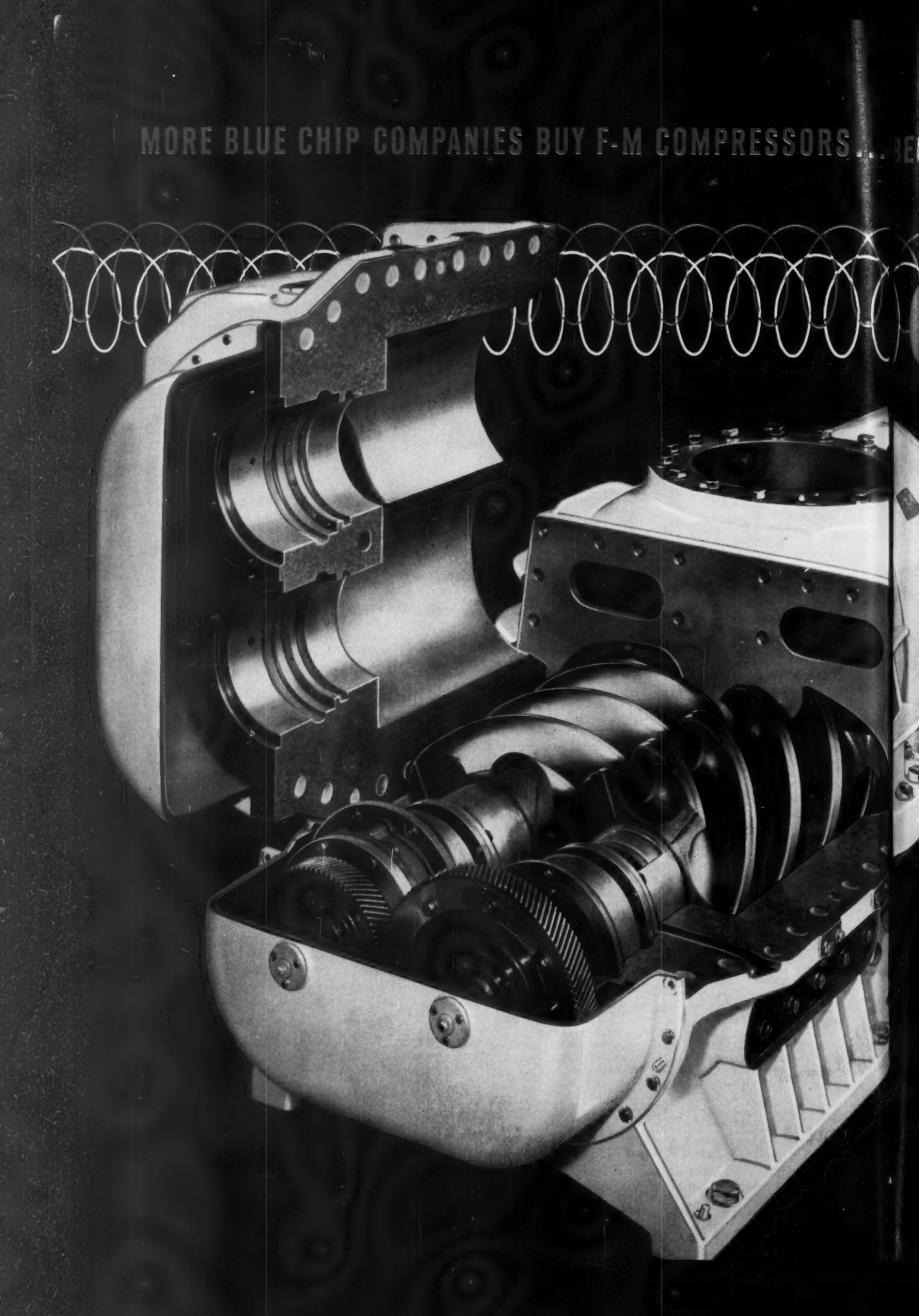
BALTIMORE, MD.
BOSTON, MASS.
BUFFALO, N.Y.
CHICAGO, ILL.
CINCINNATI, OHIO
CLEVELAND, OHIO
DAYTON, OHIO
DETROIT, (WARREN), MICH.
HOUSTON, TEX.
INDIANAPOLIS, IND.
LOS ANGELES, (WILMINGTON), CAL.
MILWAUKEE, WIS.
MINNEAPOLIS, MINN.
MONTREAL, CANADA
NEW ORLEANS, LA.
NEW YORK, N.Y.
PHILADELPHIA, PA.
PITTSBURGH, PA.
SAN FRANCISCO, CAL.
SEATTLE, WASH.
SPOKANE, WASH.
ST. LOUIS, MO.
TOLEDO, OHIO

THE ANCHOR PACKING COMPANY

GENERAL OFFICES... PHILADELPHIA, PENNSYLVANIA
FACTORIES... MANHEIM, PA. ELKHART, IND., MONTREAL, CAN.

● ***FIBROUS AND METALLIC PACKINGS FOR EVERY INDUSTRIAL PURPOSE***

MORE BLUE CHIP COMPANIES BUY F-M COMPRESSORS...



...BECAUSE MECHANICAL SIMPLICITY MEANS FAR LESS COST!

F-M ROTARY COMPRESSORS

More and more, industrial leaders are looking-to (and buying) Fairbanks Morse leadership in Compressor design. Why? Because the unique, mechanical simplicity of this *rotary* design combines maximum efficiency and reliability with low initial cost—low maintenance requirements—minimum operating costs. *And skid-mounting* cuts installation time—puts you on stream faster.

The advanced design of the F-M Axial Flow Rotary Compressor features *helical-shaped* rotors for smooth, economical compression . . . with oil-free delivery, surge-free operation on a wide variety of gases.

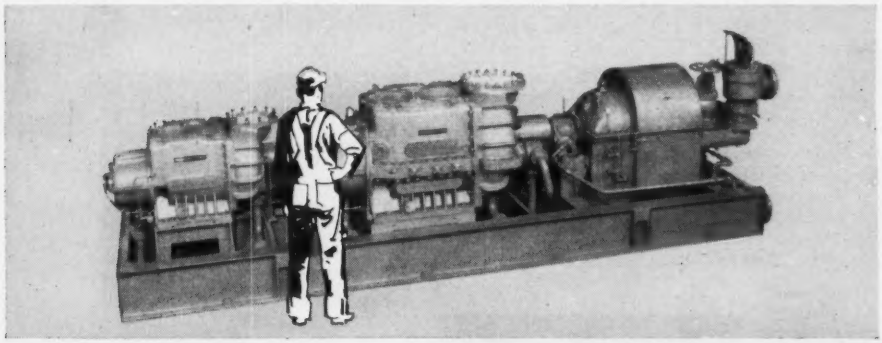
F-M Rotary Compressors have no reciprocating parts, no valves, no metal-to-metal contact in the compression chamber. Result? Minimum "down-time" expense. They save space—produce minimum vibration—provide stable performance with speed flexibility. Every Rotary Compressor built features famous Fairbanks Morse quality craftsmanship

With capacities up to 21,000 cfm—and pressures up to 250 psig, F-M Rotary Compressors are a versatile asset to many operations. Discover how it can step up the efficiency of *your* operation . . . and cut maintenance and installation costs as well. Write: **Fairbanks, Morse & Co., Director of Marketing, Compressor Division: Beloit, Wisconsin.**

THESE INDUSTRIAL LEADERS HAVE BOUGHT F-M LEADERSHIP IN COMPRESSOR DESIGN!

(What Benefits Them Can Benefit YOU)

The Algoma Steel Corporation, Limited
Celanese Chemical Co.
Copolymer Rubber & Chemical Corp.
Cyanamid of Canada, Ltd.
Deere & Company
Foster Wheeler Corporation
M. W. Kellogg Co.
Monsanto Chemical Co.
Scientific Design Co., Inc.
Shell Chemical Company
St. Paul Ammonia Products Co.
Union Carbide Chemicals Company
United Refining Co.



Skid-Mounted, Tandem Rotary Compressor ready for installation at Deere & Company, Waterloo Tractor Works.

Model 200L3/132L3 Fairbanks-Morse Rotary Air Compressor for 12,000 cfm, 110 psig. with 2600 h.p. steam turbine drive.

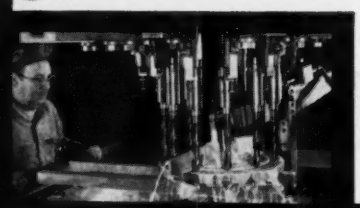
FAIRBANKS MORSE
A MAJOR INDUSTRIAL COMPONENT OF
FAIRBANKS WHITNEY

For more facts circle 297 on Reader Service card, p 103

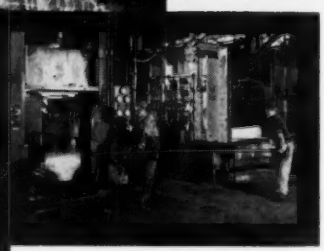
The Source for Better Service . . . a Better Product

B&W's New Fittings Plant is in FULL OPERATION

One of the mill stock bays.

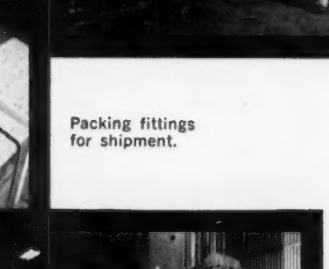


Machining a B&W flange.

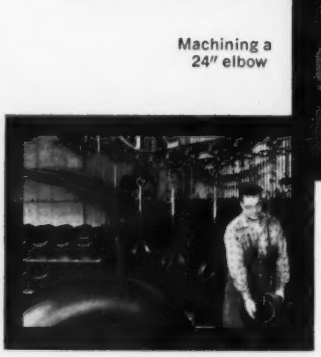


Forging a tee.

Packing fittings for shipment.



Machining a 24″ elbow



The paint line.

The transfer of B&W's welding fittings operations from Milwaukee to Beaver Falls is now complete. In full operation is the newest, most modern source for welding fittings and flanges in the industry. In full operation is a welding fittings plant that is integrated with B&W's facilities for steel and tube-making.

In terms of practical benefits to you, this means:

- You can get a complete line of welding fittings and flanges, quality controlled at every step of the production process from melt to the finished product.
- You can get a complete process piping package . . . welding fittings, flanges and tubular products from a single source . . . job-matched to end-use service.
- You can more effectively coordinate and control specifying, buying and delivery from one manufacturer.
- You can get on-time deliveries because complete integration permits flexible production schedules, particularly in the specialized steels.

For further details on how B&W's new fittings plant with its integrated facilities and services can help you, contact any of the local B&W District Sales Offices or write The Babcock & Wilcox Company, Tubular Products Division, Welding Fittings Plant, P.O. Box 230, Beaver Falls, Pennsylvania.

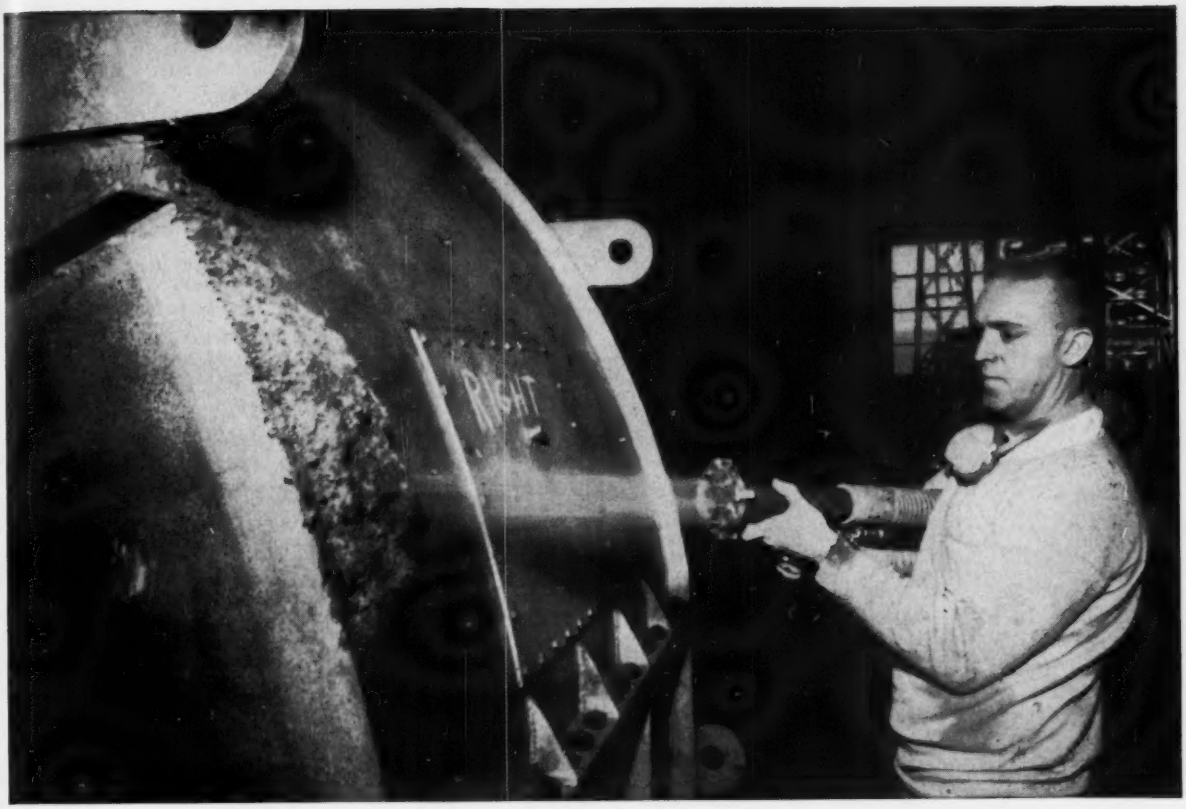
B&W

THE BABCOCK & WILCOX COMPANY

TUBULAR PRODUCTS DIVISION

TA 1020 F

Seamless and welded tubular products, solid extrusions, seamless welding fittings and forged steel flanges—in carbon, alloy and stainless steels and special metals



SPRAYED "LIMPET" ASBESTOS®
installs 25% faster than conventional thermal insulation

ON PHILADELPHIA ELECTRIC COMPANY GAS TURBINE

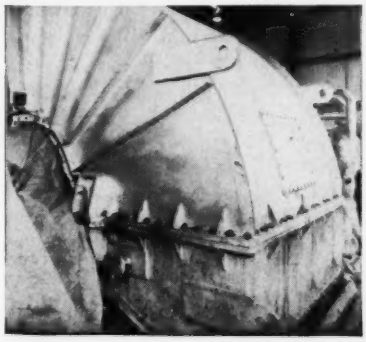
SPRAYED "LIMPET" ASBESTOS reduced labor costs, as well as installation time, at Philadelphia Electric Company's new gas turbine peaking installation on Barbadoes Island. The insulation contractor, Armstrong Contracting and Supply Corp., Philadelphia, Pa., applied this spray-shaped material to a 620 sq. ft. surface of a gas turbine exhaust fan housing in only ¼ of the time required by a conventional thermal-insulating material.

SPRAYED "LIMPET" ASBESTOS requires no mechanical supports during application. The easy, spray-gun method of application allows you up to 8″ thickness without reinforcing, in only one coating. (Thickness at Philadelphia Electric was 4″.) Soon after application, SPRAYED "LIMPET" ASBESTOS is ready for hard surfacing or weatherproofing.

This 100% asbestos insulation fits permanently, regardless of temperature changes. Withstands severe vibration, mechanical shock, frost, and Hot Face temperatures of up to 1350°F. Eliminates shakedown with time, flaking, shot fallout and deterioration.

In addition, SPRAYED "LIMPET" ASBESTOS does a number of other jobs at the same time: fire protection, noise reduction, condensation control, corrosion prevention, and dust exclusion. For more information, write to Keasbey & Mattison Company, Ambler, Pa., Dept. I-151.

No welding pins, studs, or fastening wires are required during the application to the surface of SPRAYED "LIMPET" ASBESTOS.



K·M BEST IN ASBESTOS

Keasbey & Mattison at Ambler

The felt-like, seamless blanket of SPRAYED "LIMPET" ASBESTOS faithfully follows the contours of any surface.

For more facts circle 299 on Reader Service card, p 103

Shades of the abominable snowman! There was Captain Bulkhead Jones hotfooting it through the raging snowstorm, in bare feet and dressed only in his long undies

Marmy's head-shrinkers

A blizzard roared down from the Bay of Fundy and cut across Boston harbor like a white ghost with icy fingers. But that didn't seem to bother Bulkhead Jones, captain of the tramp freighter *SS Golden Dragon.* For to the utter amazement of everyone along the large, modern Commonwealth Pier, there was the unpredictable captain, charging back to his ship in his bare feet and dressed only in long winter underwear.

Husky longshoremen bundled warmly in leather jackets abruptly stopped working cargo, wiped the snow from their hoary eyebrows and stared in disbelief at the muscular figure running up the gangplank of the *Golden Dragon.*

"Now I've seen everything," croaked Gus Schultz, supercargo for the Oriental Steamship Co, climbing down into No. 3 cargo hold to check on the mysterious disappearance of six cases of Sandpaper Gin. As he followed Fred Peterson, the *Dragon's* chief officer, he added, "between Bulkhead Jones and his chief engineer Marmaduke Surfaceblow, life aboard this tub must be like sailing in a booby hatch."

Two minutes after the captain entered his quarters under the bridge, leaving a trail of wet barefoot tracks along the port alleyway and upon the steps, two of Boston's finest banged on his door.

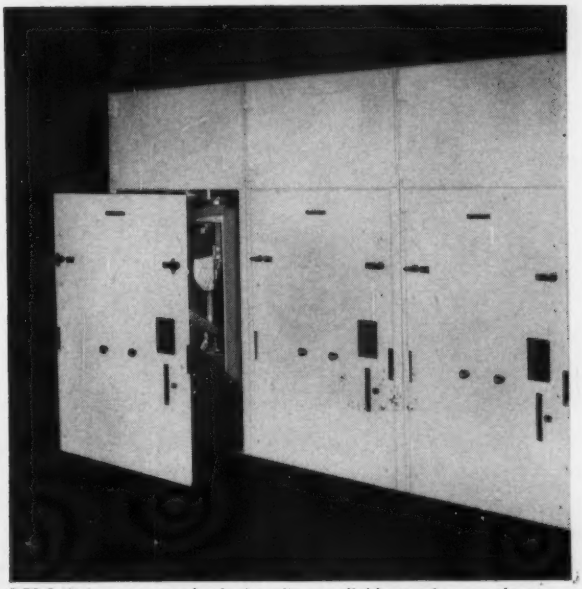
"And I'm not acarin' if ye air master o' this scow," roared Sgt Aloysius Mooney. "Ye're acomin' t' headquarters t' explain why ye parade about the streets of this God-fearin' respectable community in yer underdrawers like a heathen." And that was that.

At the police station Captain Jones explained to the chief of police that the *Golden Dragon* had been buffeted about for over a week by the angry North Atlantic, and he hadn't left the bridge in all that time. So the first night ashore he had been celebrating. Then somehow he got separated from his shipmates and in the wee hours of the morning wound up in a crap game with some professional gamblers.

After going broke, he ripped off his clothes and, with an air of bravado, rolled the dice for winner take all. So what could he do but return to his ship in his longies after the so-and-so winner *took* all and he was kicked outdoors? Cab after cab had passed him up while he shivered on a windy street corner. Only the alcohol saturating his blood kept his wirey body from freezing to stone. Again and again he pleaded, what could he do but return to his ship as he had?

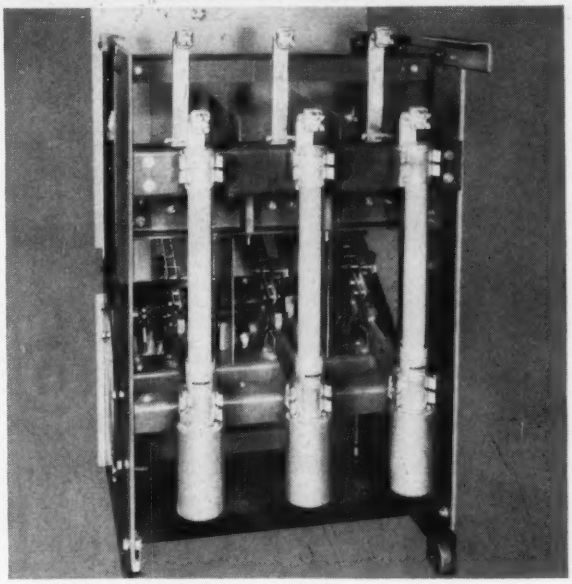
But chief of police Moriarity had run into Bulkhead Jones before. He remembered the time Bulkhead and his chief engineer "borrowed" a parked police car to drive back to their ship with siren screaming, minutes before the gangplank was raised. This time he'd teach him a lesson instead of letting him off with a light fine for disturbing the peace. He ordered Sgt Mooney to take Bulkhead to a psychiatrist for a head examination, the captain to pay the fee and all other costs. Then, after he got the doctor's report, he'd decide how to put the fear of the devil into this wild mariner, even if the shipping

New...Low-Cost, Drawout DFS Metal-Enclosed Load-Interrupter Switchgear



DFS Switchgear comes in single units or switching centers, as shown, for service entrances, transformer primary or feeder switching.

DFS drawout switch and fuse element is easily levered into cell.



DFS switch and fuse element, rear view.

Type DFS Metal-Enclosed Switchgear—*drawout fused switch*—provides compact, low-cost power switching for high voltage circuits in commercial buildings, institutions, and small industrial plants. DFS Switchgear meets a wide range of applications—with fault interrupting ability up to 250 mva at 4160 volts and 500 mva at 13,800 volts . . . load break rating 600 or 1200 amperes . . . full fault closing ability of 60,000 amperes for 5 kv and 40,000 amperes for 15 kv.

DFS Switchgear provides these major advantages:

Drawout design assures completely safe switch inspection and fuse replacement.

Component design versatility meets a broad range of applications, including automatic transfer and remote control.

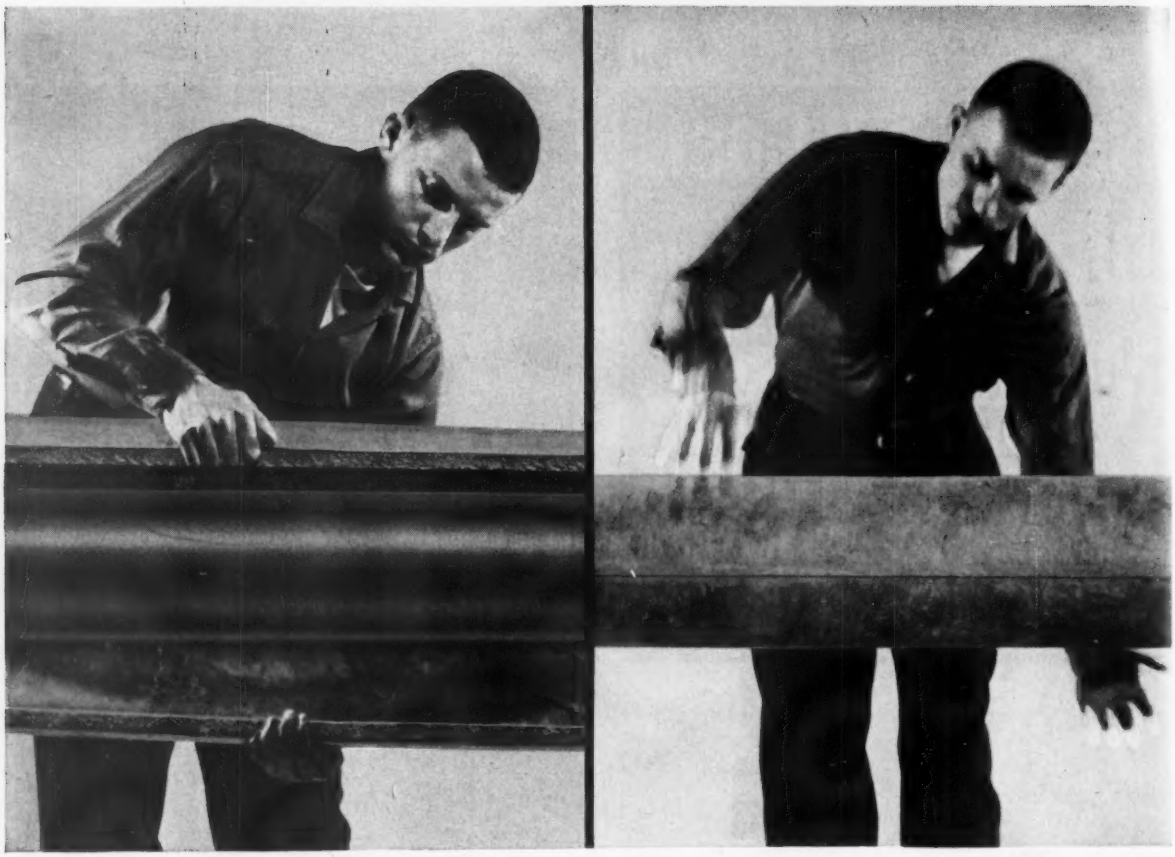
Simplified metal-enclosed construction presents compact, modern appearance.

Maximum service reliability assured by extensive High Power Laboratory design-proving tests.

For full information call your Westinghouse representative, or write Westinghouse Electric Corporation, P.O. Box 868, Pittsburgh 30, Pa., for Descriptive Bulletin 32-750. *You can be sure . . . if it's Westinghouse.*

J-61011-R1

Westinghouse



Cut installation costs up to 50%

with G-B SNAP*ON®

Simply spread G-B Snap*On open at the seam, slip over the pipe and let it snap shut—that's how easy it is to cut installation time in half with G-B Snap*On. The highly resilient glass fiber construction of this one-piece pipe insulation (in sections up to 6′ in length and up to 36″ IPS) insures a snug fit with the seams tightly butted together.

G-B Snap*On's ability to provide maximum protection against heat loss or gain is second to none among all general purpose pipe insulations. In fact, G-B Snap*On requires less insulation thickness than most other pipe coverings to provide the same insulating efficiency. Any way you look at it, you save time and money with G-B Snap*On.

WRITE FOR COMPLETE INFORMATION TODAY.

GUSTIN-BACON *Manufacturing Company*

242 W. 10th St., Kansas City, Mo.

Thermal and acoustical glass fiber insulations . . . Molded glass fiber pipe insulation . . . Couplings and fittings for plain and grooved end pipe

G-B SNAP*ON DISTRIBUTORS

AKRON, Ohio, The Asbestos Supply Co.
ALBANY, Ga., Industry Insulation Co.
ALBANY, N. Y., Hudson Valley Asbestos Corp.
ALBUQUERQUE, N. M., Mt. States Insulation Co.
AMARILLO, Tex., McDonald Engineering & Insulating Co.
ANDERSON, S. C., Building Material & Equipment Co.
ATLANTA, Ga., Reynolds Aluminum Supply Co.
Parker-Rice Insulation Co.
AUSTIN, Tex., Cinbar Engineering Co.
BALTIMORE, Md., Leroy Insulation Co.
BANGOR, Me., Eastern Glass Co.
BATON ROUGE, La., Eagle Asbestos & Packing Co.
BEAUMONT, Tex., Coburn Supply Co., Inc.
BILLINGS, Mont., Big Horn Supply, Inc.
BIRMINGHAM, Ala., Reynolds Aluminum Supply Co.
Shook & Fletcher Supply Co.
BORGER, Tex., Western Chemical & Supply Co.
BOSTON, Mass., Homans-Kohler, Inc.
BRIDGEPORT, Conn., Robert A. Keasbey Co., Inc.
BRUNSWICK, Ga., Baker Bros., Inc.
BUFFALO, N. Y., Industrial Insulation Sales, Inc.
BURLINGTON, Vt., Pipe Insulators, Inc.
CHAMPAIGN, Ill., The Lewie-David Co.
CHARLESTON, S. C., Baker Bros., Inc.
CHARLESTON, W. Va., Asbestos & Insulating Co.
CHARLOTTE, N. C., D & B Insulation Co.
CHICAGO, Ill., E.C. Carlson Co.
Culberg Asbestos & Cork Co.
CHRISTOPHER, Ill., Hoe Supply Co.
CINCINNATI, Ohio, R. E. Kramig Co.
CLEVELAND, Ohio, Ohio Asbestos & Insulation Co.
COLUMBIA, S. C., Industrial Insulation Div. of
Richland Oil Co.
COLUMBUS, Ohio, Santeler Brothers; Culberg of Ohio
CORPUS CHRISTI, Tex., Precision Insulation Co.
DALLAS, Tex., Acme Insulation & Supply Co.
DAVENPORT, Iowa., Republic Electric Co.
DAYTONA BEACH, Fla., B & F Insulation Co.
DECATUR, Ill., The Lewie-David Co.
DENVER, Colo., Plateau Supply Co.
Powers Industrial Insulation, Inc.
DES MOINES, Iowa, Iowa Asbestos Company, Inc.
DETROIT, Mich., The Walter Rankin Co.
ERIE, Pa., Laco-McMullen Co.
EVANSVILLE, Ind., Geo. Koch Sons, Inc.
FALCONER, N. Y., Laco Roofing
FT. SMITH, Ark., Gunn Distributing Co.
FT. WAYNE, Ind., M. H. Hilt, Inc.
FT. WORTH, Tex., Bracken Co.
GAINESVILLE, Fla., Baker Bros., Inc.
GRAND RAPIDS, Mich., M. S. Knee Co.
GREENSBORO, N. C., Starr Davis Co., Inc.
GULFPORT, Miss., Paine Supply Co.
HONOLULU, Hawaii, Parker Fallis Insulation Co., Inc.
HOUSTON, Tex., Precision Insulation Co.
INDIANAPOLIS, Ind., Lyon Lumber & Supply Co.
JACKSON, Miss., Paine Refrigeration Supply Co.
JACKSONVILLE, Fla., Baker Bros., Inc.
Eckles Distributors, Inc.
Reynolds Aluminum Supply Co.
JOPLIN, Mo., Joplin Cement Co.
KANSAS CITY, Mo., Central Supply Co.
Insulation & Acoustical Specialties, Inc
Kelley Asbestos Prod.
KEWANEE, Ill., Mechanical Insulation Co., Inc.
LAKE CHARLES, La., Coburn Supply Co., Inc.
Solar Supply Co.
LITTLE ROCK, Ark., Gunn Distributing Co.
LOS ANGELES, Calif., Accurate Insulation Co., Inc.
Western Fibrous Glass Products Co.
LOUISVILLE, Ky., General Insulation & Roofing Co.
MACON, Ga., Industry Insulation Co.
MARIETTA, Ohio, Asbestos & Insulating Co.
MEMPHIS, Tenn., Gibbons Supply Co.
MIAMI, Fla., Reynolds Aluminum Supply Co.
Southern Metal Products Co.
MILWAUKEE, Wisc., F. R. Dengel Co.
MINNEAPOLIS, Minn., Asbestos Products, Inc.
MOORHEAD, Minn., Fargo-Moorhead Insulation Co.
NASHVILLE, Tenn., Reynolds Aluminum Supply Co.
NEWARK, N. J., Eastern Steam Specialty Co.
Robert A. Keasbey Co., Inc.
NEW ORLEANS, La., Eagle Asbestos & Packing Co.
NEW YORK, N. Y., Eastern Steam Specialty Co.
Robert A. Keasbey Co., Inc.
OKLA. CITY, Okla., Ball Distributing & Engineering Co.
OMAHA, Nebr., Cardinal Supply & Mfg. Co.
ORANGE, Conn., Insulation Supply Co.
ORLANDO, Fla., Baker Bros., Inc.
PADUCAH, Ky., Triangle Insulation Co.
PHILADELPHIA, Pa., John F. Scanlan, Inc.
PHOENIX, Ariz., Williams Insulation Co.
PITTSBURGH, Pa., Dravo Corp., Keystone Div.
PORTLAND, Me., Eastern Glass Co.
PORTLAND, Ore., Western Fibrous Glass Products Co.
RALEIGH, N. C., Reynolds Aluminum Supply Co.
RAPID CITY, S. D., Robbins & Stearns Wholesale
RICHMOND, Va., Reynolds Aluminum Supply Co.
ROANOKE, Va., C. E. Thurston Co.
ROCKFORD, Ill., Mott Brothers Co.
SACRAMENTO, Calif., The Brookman Company
SALT LAKE CITY, Utah, Bullough Asbestos Supply Co.
SAN ANTONIO, Tex., San Antonio Machine & Supply Co.
SAN DIEGO, Calif., Western Fibrous Glass Products Co.
SAN FRANCISCO, Calif., Western Fibrous Glass Products Co.
The Brookman Company
SAVANNAH, Ga., Baker Bros., Inc.; The Brower Co.
Reynolds Aluminum Supply Co.
SEATTLE, Wash., Western Fibrous Glass Products Co.
SHREVEPORT, La., Frith Sales Co.
SOMERVILLE, Mass., Insulation Products, Inc.
ST. LOUIS, Mo., Refrigeration Supplies, Inc.
The Stovey Company, Inc.
ST. PAUL, Minn., Asbestos Products, Inc.
SYRACUSE, N. Y., Burnett Process, Inc.
TALLAHASSEE, Fla., Baker Bros., Inc.
TAMPA, Fla., Eagle Roofing & Art Metal Works, Inc.
TULSA, Okla., Ball Distributing & Engr. Co.
TUPELO, Miss., Paine Supply Co.
VALDOSTA, Ga., Baker Bros., Inc.
WASHINGTON, D. C., Walter E. Campbell Co., Inc.
WEST PALM BEACH, Fla., Southern Metal Prod.
WICHITA, Kans., Wichita Sheet Metal, Inc.

S*O 2-15-61

Marmaduke

Begins on page 146

line did insist he was the best captain on the high seas.

Two hours later Bulkhead Jones was sitting in the reception room of Dr Paul Liebwitz, psychiatrist. He was accompanied by Sgt Mooney who stared at him suspiciously from time to time.

Just as the receptionist announced, "you may go in now," the hall door opened abruptly and Marmaduke Surfaceblow, chief engineer of the *SS Golden Dragon*, barged in.

"I've been bird-dogging for your tracks all morning, Bulkhead, but I just picked up your trail," roared this unusual character in his foghorn voice. "I'll put the squeeze on'ta the boys aboard for enough dough to keep you out of the jug after you get your noggin calibrated." Then he added, "but it won't be easy because everyone blew their wad ashore last night."

"Gentlemen! Gentlemen!" shouted Dr Liebwitz nervously, sticking his bald head out of his office, "won't you kindly keep your voices down? Through these thin walls you sound like an engine backfiring."

"Noisy building?" rasped Marmaduke, even louder than before, perking up his ears at this slightest clue to making some easy money. "Last trip I made to this bean port, I read where this is the most modern doctors' building in America. How come it isn't soundproof?" he probed casually.

"Ask those two gentlemen," answered the doctor impatiently, nodding towards two men talking quietly in one corner of the reception room. Just then both men got up and walked towards the doctor and Marmaduke.

"I've been sitting here with your building superintendent, Dr Liebwitz, and, exactly as you complained, I could hear almost every word you and your patient were saying through your closed door," said one of the men. "I can see why your patients complain. It was most embarrassing. You discussed rather intimate things."

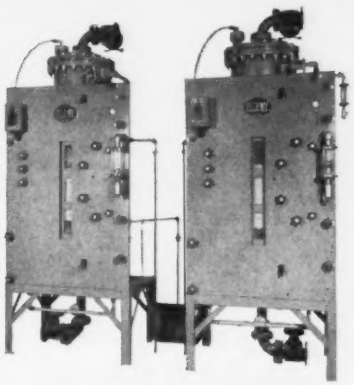
"Yes, we must do something, no doubt about that, doctor," gravely commented the building super. "Mr Dirkson and I checked several offices. As you know, all our doctors are com-

ILLCO-WAY DESIGNERS AND BUILDERS

MODERN EQUIPMENT FOR ionXchange

HIGH FLOW RATE

CONDENSATE SCAVENGERS



FOR CONVENTIONAL POWER PLANTS

You may know that some of the new, fantastic, super-critical, once-through power plant boilers use elaborate condensate-scavenging demineralizers. Since 1951, however, IWT has supplied *less complex* but highly effective and economical de-ionizers for condensate scavenging to various "conventional" power plants. These operate on a by-pass system, de-ionizing a portion of the total condensate stream, to produce a marked improvement in conductivity and silica in the boiler water and a corresponding reduction in costly blowdown. Initial investment and operating costs are modest.

"PACKAGED" FOR EASY INSTALLATION

The picture above shows a typical twin-condensate-scavenger installation consisting of parallel Mixed-Bed De-Ionizers. Each of these units is shipped fully-assembled, as a complete "package," with the tank, piping, valves and instruments all installed, connected, and tested. The tank is filled with resin and the unit is ready to operate. (U.S. Patents 2,605,084 and 2,771,424.)

CALL YOUR IWT MAN

Your nearest IWT Representative is equipped by experience to advise you well not only in the possible applications of these condensate scavengers, but also with respect to many other water-treatment problems.

ILLINOIS WATER TREATMENT CO.
840 CEDAR ST., ROCKFORD, ILLINOIS
NEW YORK OFFICE: 141 E. 44th St., New York 17, N.Y.
CANADIAN DIST.: Pumps & Softeners, Ltd., London, Ont.

circle 302 on Reader Service card, p 103

FOR BEST SERVICE

pumping light and heavy fuel oil — install

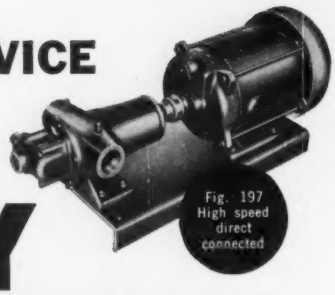


Fig. 197 High speed direct connected

HEAVY DUTY

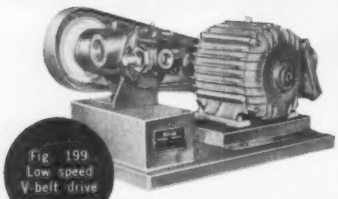


Fig. 199 Low speed V-belt drive

VIKING PUMPS

These two Viking Pumps combine all the qualities you want for smooth, positive delivery of light and heavy fuel oils, lube oils and other petroleum products. Figure 197 is a high-speed, direct connected pump and Figure 199 is a low-speed, heavy-duty unit.

Capacities range from 3 to 30 G.P.M. Speeds, 600 to 1800 R.P.M. Temperature range, —40 to 225 degrees F. Viscosity range, 100 to 10,000 S.S.U.

All are built for continuous or intermittent duty in such applications as filtration, circulation, transferring and booster service.

For additional information ask for bulletin SP-522W

50 YEARS

VIKING PUMP COMPANY

Cedar Falls, Iowa, U.S.A. • In Canada, It's "Roto-King" Pumps

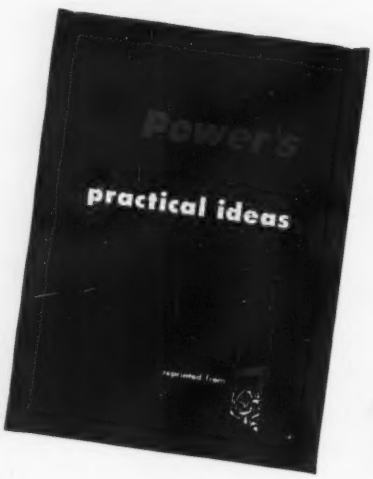
See Our Catalog In Sweet's Industrial Construction and Plant Engineers File

For more facts circle 303 on Reader Service card, p 103

NEW!

POWER'S practical ideas

62 pages of the most practical, informative data found anywhere. Taken from the pages of POWER. Illustrated, plastic bound. New handy size. Only $1.00



ORDER NOW

POWER Reader Service Dept, 26th Floor
330 West 42nd Street
New York 36, N. Y.

Please send me _____ copies of the new "Practical Ideas." I enclose $1.00 for each copy ordered.

Name (Please print or type) _____

Street Address _____

City _____ Zone _____ State _____

Marmaduke

Begins on page 146

plaining that even a whisper can be heard in the waiting rooms. I've been deluged with calls daily since we moved in last Monday."

"It won't be cheap," cut in Dirkson. "Transmission of speech from office to office is occurring through common ducts and door grilles and openings around piping and other services. But my noise treatment will eliminate your problem. I figure I'll have to insulate every reception room wall on all eight floors. Then I'll substitute better-fitting doors without grilles. You see, this building is quiet, and the partitions thin. Situation is just the opposite of buildings with noisy machinery."

"I told Mr Dirkson he's the fourth contractor we've called in so far. And each one has his own ideas on quieting these offices," explained the super. "But regardless of who does the work, it looks like it may be a $100,000 job."

"What?" shrieked Dr Liebwitz so loudly that a doctor from next door rushed in to investigate.

"You don't have to spend that kind of cabbage," suddenly bellowed Marmaduke as his electronic brain shifted into high gear to solve the problem. "I'll block that noise and do it more completely and cheaper than any offer you've had so far. Are you interested?" he yelled, looking the superintendent straight in the eye.

"Why, I don't even know your name," stuttered the super.

"The name's Marmaduke Surfaceblow, chief of the *SS Golden Dragon*," roared the 6-ft 4-in. character, extending a bear-like paw to the startled super. "I've stopped noise, vibration, dust and corrosion from Rangoon to Astrakhan. I'll give you two cures, one a bargain-basement job you can use pronto for a few bucks and a second one that's still a bargain, but on the carriage-trade level. You can complete the first cure today—but you'll eventually want the second because it goes with your building like a sailor with a mermaid. I offer them both on a cash-and-carry basis."

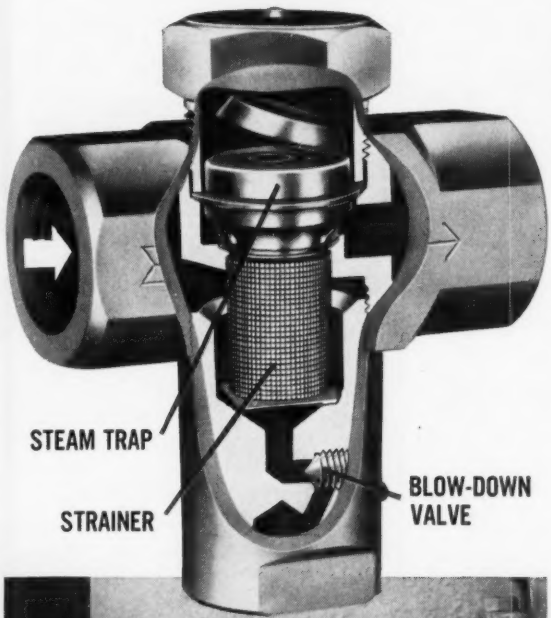
"This is a cooperative enterprise, Mr Surfaceblow," explained the superintendent, eyeing the stranger suspiciously. "200 doctor-tenants own

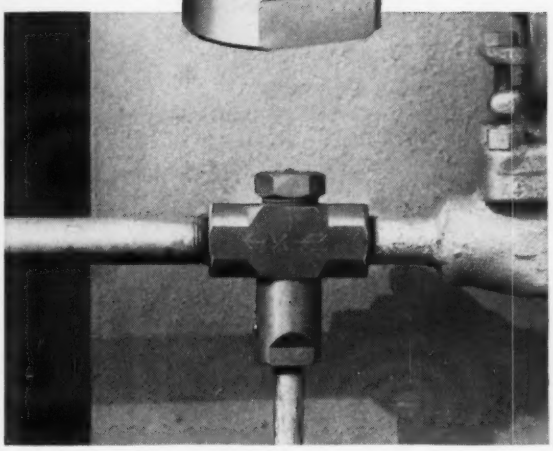
YARWAY news briefs

from **Yarnall-Waring Company,** *Philadelphia 18, Pa.*

BRANCH OFFICES IN 19 UNITED STATES CITIES • SALES REPRESENTATIVES THROUGHOUT THE WORLD
STEAM TRAPS STOCKED AND SOLD BY 270 LOCAL INDUSTRIAL DISTRIBUTORS

3 REASONS WHY NEW YARWAY SERIES 130 IMPULSE STEAM TRAP SCORES BIG SUCCESS





This new Yarway all-in-one combination steam trap, strainer and blow-down valve—designed especially for moderate condensate load applications—is winning enthusiastic approval from users everywhere. Here's why:

it saves space

Entire trapping hook-up can fit into an area no larger than a "T" fitting. Straight-through piping, cleaner installations, more accessibility.

it saves money

Only one unit to buy—plus much lower installation and maintenance costs—results in large savings over conventional trap installations. A fair estimate—*UP TO 30% IN TIME AND MATERIALS!*

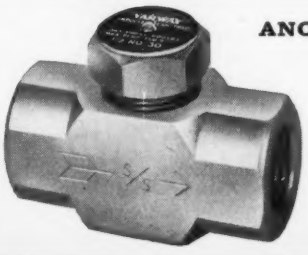
it saves work

No more installation headaches. As easy and quick to install as a pipe fitting. Maintenance is a breeze. Blow-down valve is operated by simple Allen wrench.

SERIES 130 traps are good for all pressures 8 to 600 psi, stainless steel throughout, have replaceable trap valve and seat, woven stainless steel strainer.

Why not try this compact combination on a steam main drip, tracer line or other moderate load application in *your* plant? Your nearby Yarway distributor can now supply you. For more details on Yarway Series 130 traps, write for Bulletin T-1743B.

Yarway Series 130 Impulse Steam Trap draining drip on 700 ft. house heating line at Eddystone Station of Philadelphia Electric Co. Pressure 150 psi; temperature 385° F.



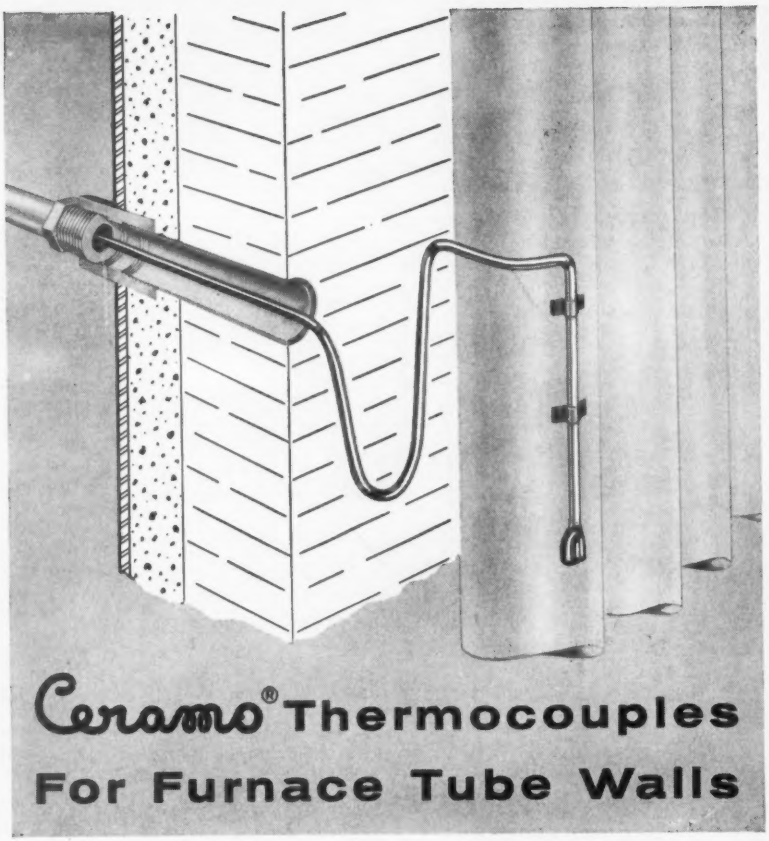
ANOTHER POPULAR YARWAY IMPULSE STEAM TRAP—SERIES 30

This is the "trap" part of the Series 130 described above—but without combined strainer and blow-down valve. Gives peak efficiency on moderate condensate load applications. Offers these features:

- Economy of operation, with close condensate control
- Long service life, with lever action reducing impact in valve seat
- Low maintenance; easily replaceable seat and disc
- High quality, all stainless steel—with a new *low cost*

Write for Yarway Bulletin T-1743.

For more facts circle 305 on Reader Service card, p 103



Ceramo® Thermocouples
For Furnace Tube Walls

Cut Installation Time 75%

Installation time, always a high-cost factor with furnace tube wall thermocouples, has now been reduced up to 75% by Thermo Electric. Responsible for this reduction is T-E's "Ceramo" construction—ceramic-insulated conductors with overall metal sheathing. Conventional, rigid assemblies were both costly and difficult to install. "Ceramo" furnace tube wall thermocouples virtually eliminate these difficulties.

Applications

These thermocouples measure the increase in outer tube wall temperature when coking or scaling of the inner wall causes a loss of heat transmission. They are used on furnace tubes, superheaters, pre-heaters, and for determination of start-up temperatures.

Advantages

"Ceramo" furnace tube wall thermocouples can be bent to almost any shape—greatly simplifying difficult installation around tubes.

Large holes in the furnace wall, previously required to accommodate the motion of old-style, rigid assemblies, are no longer necessary. "Ceramo," though basically rigid, will flex with the differential motion between tubes and furnace wall. "Hot spots," resulting from faulty insulation around large, rigid assemblies, are also eliminated.

Since "Ceramo" measuring junctions are completely enclosed, they need only be tack welded to the tube wall. There's no need to seal-weld the entire outer end of conventional, open-end protection tubes. "Ceramo" is generally used *without* protection tubes.

"Ceramo" construction provides extremely small O.D.'s—ranging from 1/16" to 7/16".

Write For Bulletin EDS-45-42.

Thermo Electric CO., INC.
SADDLE BROOK, NEW JERSEY

In Canada: THERMO ELECTRIC (Canada) LTD., Brampton, Ont.

For more facts circle 306 on Reader Service card, p 103

Marmaduke

Begins on page 146

this building. We're having a meeting in our penthouse tonight at 8 pm. The main problem we'll tackle is this one of acoustical correction. Mr Dirkson and the other three contractors will be there. I suggest you show up also and give us your proposition. Dr Liebwitz here is president of the corporation so I'm sure he'll want you to attend."

"By all means," quickly answered the doctor, studying Mr Surfaceblow intently for the first time.

"I'll be on deck," barked Marmaduke, "and you can forget about shelling out a lot of money." Then he hurriedly scribbled something on a piece of paper he grabbed from the receptionist's desk, handed it to Dr Liebwitz and, with a "see you aboard ship, Bulkhead," barged through the door.

That evening at 8 pm when Marmaduke showed up in the penthouse, the large room was packed in spite of the rough weather. There was no doubt about the importance of the thin-wall problem to the tenants of the building. A cost of $100,000 represented $500 out of each stockholder's pocket.

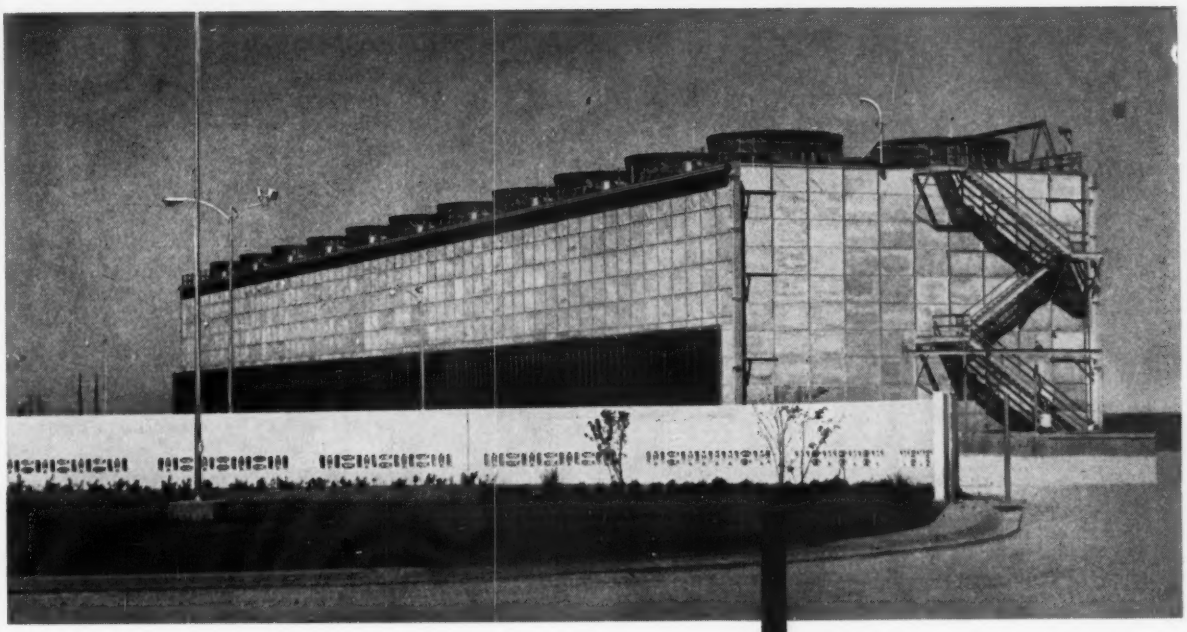
Marmy removed his gray bowler and heavy overcoat, then leisurely lit a long black cigar. Every eye was on the tall, erect figure as he strode up to Dr Liebwitz, the chairman. The doctor showed him a seat in the front row, next to the four contractors waiting to make their propositions. Then the meeting began.

For half an hour Marmy heard each contractor in turn give his pitch. Costs ranged from $56,000 to $86,500. Each had a different idea, but basically the solutions all had to do with insulating the walls and doors. They proposed everything from lining the consultation rooms with a new decorative acoustical material, to filling the walls with insulation. Finally it was Marmaduke's turn.

"BILGEWATER on using a sledgehammer to drive tacks," roared Marmaduke as he jumped to his feet. Then he faced his audience, hooked his thumbs into the armpits of his checkered vest and blasted away. "I'll cure your patient and it won't cost you head-shrinkers much more than $5000 for my professional services.

continued

FLUOR COOLING TOWERS



* You'll get more cooling at lower cost, and longer tower life under all operating conditions with Fluor Cooling Towers. From heavy industrial installations to light central station air conditioning and refrigeration units, there's a Fluor Cooling Tower to meet your specific needs.

higher performance

lower maintenance cost

built-in permanence *

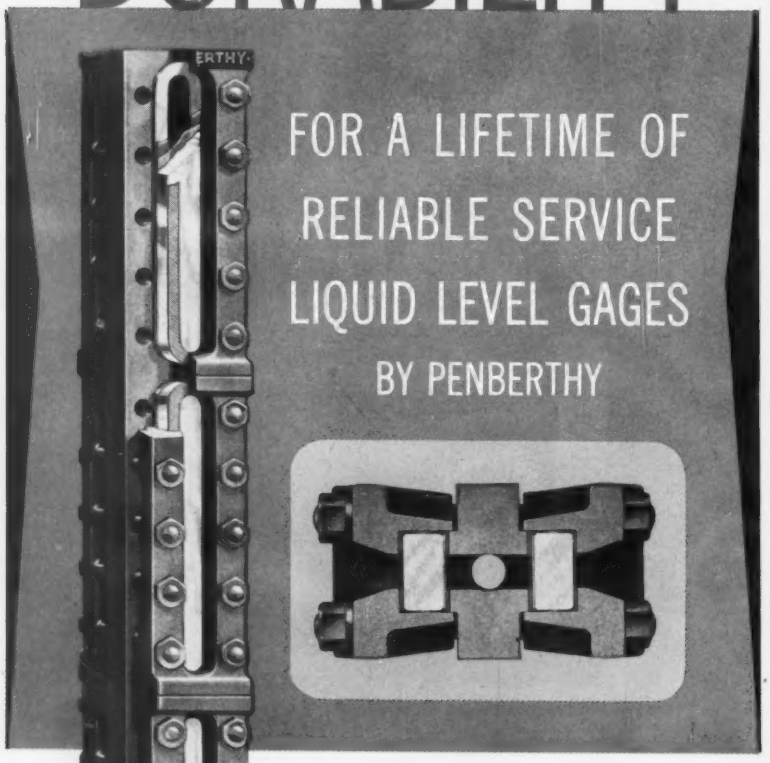
Fluor PRODUCTS COMPANY COOLING TOWERS

A division of The FLUOR CORPORATION, Ltd.

FOUNDER MEMBER CTI COOLING TOWER INSTITUTE

GENERAL OFFICES: P. O. Box 1267, SANTA ROSA, CALIFORNIA

DURABILITY



Design, materials, construction are combined in the manufacture of Penberthy Liquid Level Gages to provide the highest degree of rugged dependability. Liquid chambers are made in one piece from a solid bar of carbon or alloy steel and precision heat treated, machined and ground . . . for perfect, leak-tight alignment and rigidity. Covers, of temperature resistant steel, completely enclose sides and ends of glass and gasket . . . for blowout prevention. Pyrex glass is used exclusively . . . for its greater strength and resistance to shock and erosion. Even the gasket material is specially selected . . . for its high resiliency and ability to withstand excessive compression. In brief . . . For *lasting* accuracy in a liquid level gage, look to Penberthy.

PENBERTHY MANUFACTURING COMPANY
Division of Buffalo-Eclipse Corporation
PROPHETSTOWN, ILLINOIS
SALES OFFICE: 2660 E. GRAND BLVD., DETROIT 11, MICH.

PENBERTHY
Dedicated to Quality Since 1886

LOOK TO PENBERTHY FOR JET PUMPS, TOO

WRITE OR CALL PENBERTHY TODAY FOR COMPLETE INFORMATION

For more facts circle 308 on Reader Service card, p 103

Marmaduke

Begins on page 146

That's right, only $5000 bucks—but I'll ask you to shell out before the *Golden Dragon* sails on Saturday morning."

Suddenly it was so quiet you could hear Dr Liebwitz's stepped-up asthmatic breathing as he quickly calculated the tremendous savings suggested by this ship's engineer. All eyes were glued on Marmy. "Now, before I say more," he continued, "I want to know right now if you'll agree to make out a check for me tonight if you accept my scheme. Otherwise I'll clam up and you can go ahead and hock Fort Knox for these contractors."

"We've got nothing to lose," said Dr Liebwitz enthusiastically. "Let's have a show of hands, gentlemen."

Every hand in the large smoke-filled room suddenly shot up like a sailfish breaking the surface when trying to dislodge a hook.

"OK," rasped Marmy, "that's good enough for me. Now you sawbones forget about doing major surgery on this tender new building. The remedy is as simple as a dose of castor oil. All each of you has to do is place a noisy electric fan in your reception room. That'll mask any sound from the consultation room. And you can put in this sure cure tomorrow without any bloodletting."

"Hurray," shouted one of the doctors. Then a thunder of laughter drowned out all conversation as the simplicity of Marmy's solution sunk into their heads.

"But here's the permanent cure, and it's as pleasant as a sugar-coated pill," continued Marmy when the room quieted down. "Install a functional music system. A soothing background of classical music can be piped into all the reception rooms from a central recorder. That will drown out any voices from the consultation rooms, and it'll be pleasing to your patients besides. If the records are well selected, your patients won't even mind waiting.

"Instead of keeping the voices from coming through the walls and doors, like these wood-butchers propose, I suggest just the opposite. Mask the objectionable voices with pleasant background music. Then your build-

circle 309 on Reader Service card, p 103 ➤

For reliability, low cost, good looks specify Armstrong Armaflex 22

Armaflex 22 is a foamed plastic pipe insulation that stops condensation on cold lines and saves heat on hot lines to 220° F. An Armaflex job is reliable, low cost, and neat.

Reliable—The proper thickness of Armaflex 22 stops condensation permanently. Its closed-cell structure forms a vapor barrier all the way through—requires no finish or jacket indoors.

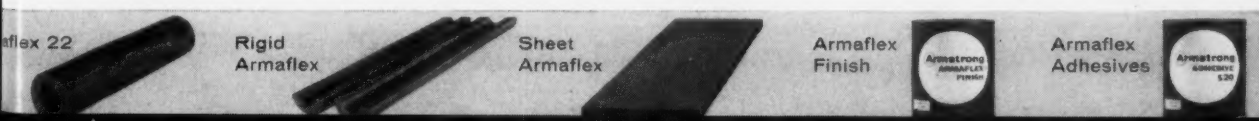
Low Cost—Armaflex goes on fast—cuts labor costs. All the workmen do is apply the covering and seal the joints with Armstrong 520 Adhesive. Fitting covers are quickly made from miter-cut pieces and applied the same way. Many contractors report savings of 50%, particularly where many fittings are involved.

Neat Appearance—The smooth black surface of Armaflex 22 makes a neat finished job. For a de luxe job, gray or white Armaflex Finish can be brushed on.

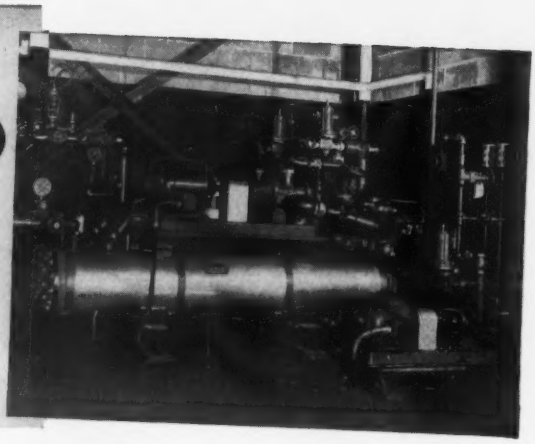
Armaflex 22 is one of a complete line of Armaflex products for insulation jobs from below zero to 220° F. Also included are Rigid Armaflex for use at pipe hangers and other places where compression is a problem; Armaflex Sheet for tanks, vessels, large pipes, and fittings; Armaflex Finish for outdoor applications and an especially attractive appearance indoors or out; plus the special Armstrong adhesives that insure a neat and reliable job.

For your copy of the Armaflex Specifier Portfolio, which contains complete data on the products in the complete Armaflex line, plus detailed specifications on their application, write today on your company letterhead to Armstrong Cork Company, 2205 Riggs Avenue, Lancaster, Pennsylvania.

Armstrong INSULATIONS



2 ENCO FUEL OIL UNITS *in this plant*



Here is a typical 2 unit installation of Enco fuel oil pump sets—selected to take care of all the requirements of a building materials manufacturer.

The Large Unit has 2 pumps and 2 heaters, completely automatic and arranged for operation with either heater, or either pump—or both. With one heater and pump the capacity is 11 gpm Bunker C oil at 300 psig pressure, and temperature rise from 90F to 230F.

The Small Unit is for cold starting up—has no heater. The capacity is 3 gpm of No. 2 oil at 300 psig pressure.

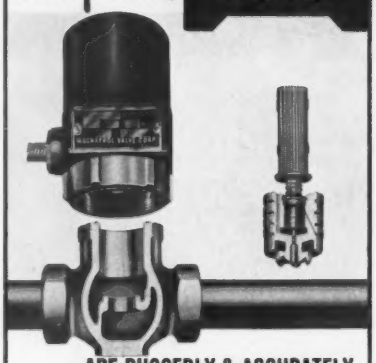
All Enco sets are individually designed, each for specific plant conditions—for easy installation, low maintenance and minimum carefree operation.

Complete details including the 10 important features of Enco fuel oil heating and pumping sets are given in Bulletin OB53. Copies gladly sent upon request.

THE ENGINEER COMPANY, 75 West Street, New York 6, N. Y.
In Canada: Rock Utilities Ltd., 80 Jean Talon St. W., Montreal, P. Q.
Palser Enterprises, 378 York St., London, Ontario EC-807

For more facts circle 310 on Reader Service card, p 103

Magnatrol SOLENOID VALVES



. . . ARE RUGGEDLY & ACCURATELY CONSTRUCTED TO GUARD AGAINST COSTLY FLOW FAILURES.

The entire operating mechanism of Magnatrol Solenoid Valves can be cleaned, repaired or replaced WITHOUT removing the valve body from the pipe line or breaking flexible electrical leads.
This unusual design advantage plus the fact that every Magnatrol Valve is CUSTOM ASSEMBLED and FACTORY TESTED . . . means greater dependability.
Available in normally closed and normally open models, in pipe sizes from 1/4" to 3". Pressure ranges from zero up to 500 psi.

Catalog mailed upon request.

Magnatrol VALVE CORP. Hawthorne 10, New Jersey

circle 311 on Reader Service card, p 103

WELD STAINLESS FASTER!

Use **AIRCOMATIC**®—Airco's gas shielded metal arc process. Terrific on austenitic plate ⅛" and over. For unbiased advice on any stainless application, call Airco—the only producer of complete equipment for Aircomatic, Heliwelding and stick electrode welding.

AIRCO **AIR REDUCTION SALES COMPANY**

A Division of Air Reduction Company, Incorporated, 150 East 42nd Street, New York 17, N. Y. • On the west coast—Air Reduction Pacific Company • Internationally—Airco Company International • In Canada—Air Reduction Canada Limited • All divisions or subsidiaries of Air Reduction Company, Inc.

circle 312 on Reader Service card, p 103

Marmaduke

Begins on page 146

ing will really be modern and pleasing to all your visitors."

Marmaduke stopped talking. For an instant you could have heard a clam close. Then the good doctors sent up a thunderous applause and rushed to shake his hand.

When the room quieted down, Dr Liebwitz asked again for a show of hands for presenting this unusual character with a $5000 check on the spot. The vote was unanimous.

Shortly thereafter Dr Liebwitz, Marmy, the superintendent and several of the doctors were celebrating with a lobster dinner at Boston's famous Locke-Ober restaurant on Winter Place. After drinking a toast to the ingenious solution of the thin-wall problem, Marmy turned to the good doctor.

"Did you do anything about that note I gave you in your office?" asked Marmy, with a twinkle in his eye.

"Sure did," answered Doctor Liebwitz, smiling. "Just as you requested, I won't send a report to police chief Moriarity until tomorrow. And since I've heard your sensible proposition tonight, you and your Captain Jones can rest assured that my report will be favorable. I'll suggest that the best way to keep an old salt like Bulkhead Jones from getting seasick ashore is to send him off to sea as soon as possible."—STEVE ELONKA

Marmy's mail

LAYMAN'S FRIEND

That Marmy collection of stories is something. I found his yarns most interesting and enjoyable. It's amazing how much a layman like myself can learn from his stories.

A F HOBBS, *Seattle, Wash.*

MARMY DELIGHTFUL

I do technical writing for the U.S. Dept of Labor. Recently I saw a copy of *The Marmaduke Story*. Although I'm a girl, I found the stories delightful.

M M TROXELL, *Washington, D.C.*

circle 313 on Reader Service card, p 103

HP

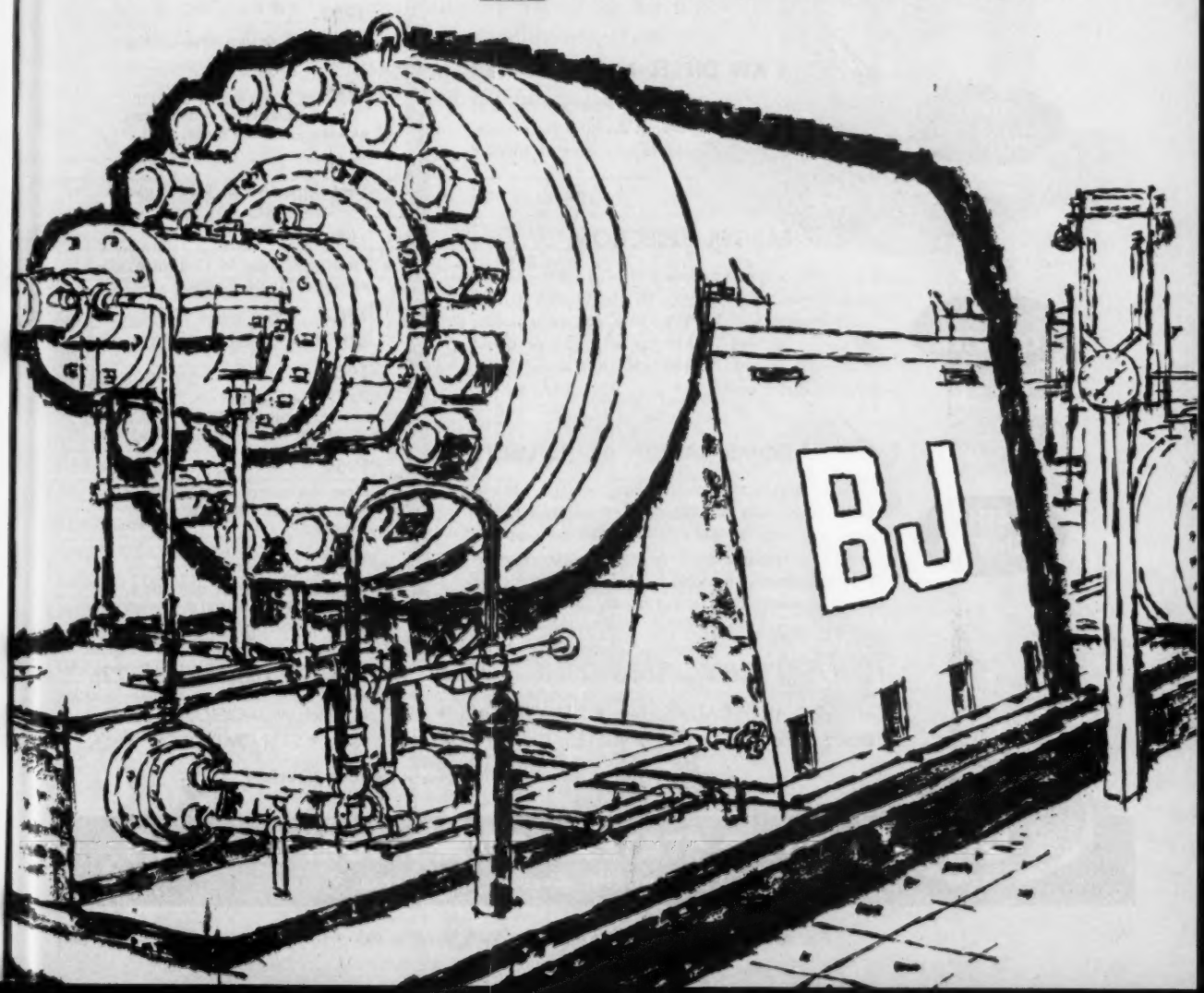
When it comes to high horsepower pumps, BJ is the big leader!

Six recent Byron Jackson orders for a total of eleven boiler feed pumps all ranged from 7,000 to 12,000 horsepower and will deliver from 3,000 to 6,750 gallons per minute!

This dramatically points up the trend toward larger, higher horsepower pumps, both standard, steam turbine and direct turbine–generator driven. And since reliability is a must with these modern, big capacity boiler feed pumps, BJ's reputation for quality and proved performance really pays off!

BW

BYRON JACKSON PUMPS, INC.
SUBSIDIARY OF BORG-WARNER CORPORATION
P.O. Box 2017A, Terminal Annex, Los Angeles 54, California



YOUR CALENDAR OF

MICRO POWER "no-break" POWER EVENTS FOR 1961

..by UNITED STATES MOTORS CORPORATION

1ST QUARTER

New BRUSHLESS GENERATORS

U. S. Motors 5 to 20 kw capacity Micro Power units will feature new "brushless" generators to eliminate brush and slip ring maintenance requirements. The no-break units will also operate at plus or minus 1 per cent voltage regulation to satisfy increasing sensitivity of critical operating equipment.

2ND QUARTER

New 5 KW DIESEL MICRO POWER

5 KW capacity "diesel" Micro Power units will be available to fulfill growing demand for a thoroughly dependable power supply unit of smaller capacity.

3RD QUARTER

New LARGER SELECTION

The most complete selection of Micro Power units ever offered will be ready by the second half of '61. Included will be 1½-3 kw gas, or gasoline units — 5, 10, and 15 kw gas, gasoline, or diesel units — 20, 30, 50, 75, 100, 150, 200, and 300 kw capacity diesel units.

4TH QUARTER

New COMBINATION AC/DC UNITS

For the first time, combination AC/DC Micro Power units will be offered in 3 kw and larger capacities with 48 or 129 volt DC current for energizing transistorized microwave communications equipment, and 120/240 volt AC current for handling non-critical power needs.

GROWING STEADILY TO MEET YOUR MOST CRITICAL POWER REQUIREMENTS

1952
First Micro Power Unit.

1953
Intensified design and testing program initiated.

1954
First shipments of 3 KW gas, gasoline Micro Power.

1955
First shipments of 5 KW gas, gasoline Micro Power.

1956
First shipments of 10 KW gas, gasoline Micro Power.

1957
First diesel Micro Power Unit.

1958
Further expansion of research-testing program. First 50 KW Micro Power Unit unveiled.

1959
First shipments of 10 KW diesel Micro Power. 100 KW unit designed.

1960
Over 2000 units in operation. Larger capacities on the way.

authorized sales and service representatives in

CHICAGO, Ill. • DALLAS, Tex. • DENVER, Colo. • DETROIT, Mich. • JACKSONVILLE, Fla.
JERSEY CITY, N. J. • LOS ANGELES, Calif. • PORTLAND, Ore. • SAN FRANCISCO, Calif.

consult the classified section of your phone directory

UNITED STATES MOTORS CORPORATION
MICRO US POWER
OSHKOSH • WISCONSIN

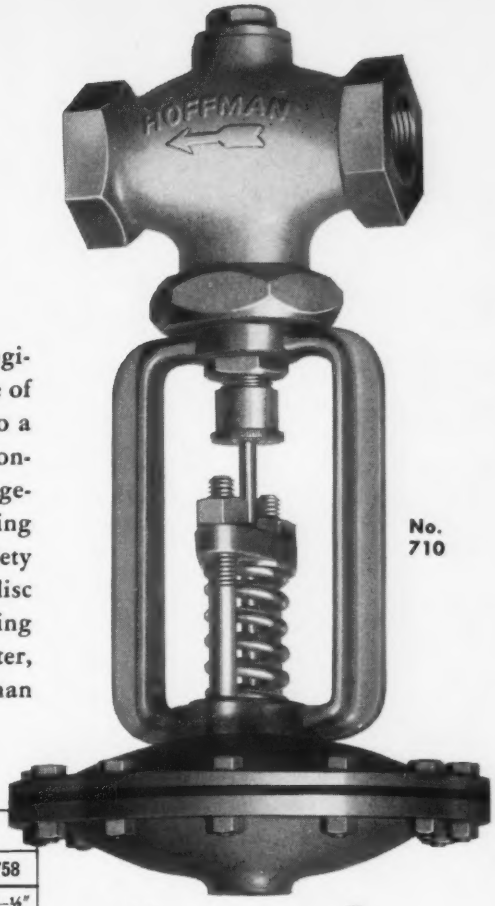
UNITED STATES MOTORS CORPORATION
102 West Fifth Avenue • Oshkosh, Wisconsin

For more facts circle 314 on Reader Service card, p 103

Hoffman Industrial Specialties *for air, water, steam or other fluids . . .*

Do you have a Pressure Reducing PROBLEM?

Hoffman Pressure Reducing Valves are designed and engineered for a wide range of applications where pressure of fluids must be reduced from a higher initial pressure to a lower secondary pressure. Single seated, dead-end or continuous operation. All parts are renewable and interchangeable. Valve seat and disc can be changed without removing valve body from the line. Easily adaptable to a wide variety of services, depending on the type diaphragm and disc used. Hoffman has Pressure Reducing Valves for heating equipment . . . process work . . . air conditioning . . . water, air, or gas. Check your requirements! Select the Hoffman Valve you need! Or write for further information!



No. 710

PRESSURE REDUCING VALVE SELECTION CHART								
	700	710	715	720S	720W	740	750	758
SIZE—Inches	½–8″	½–1½″	2–4″	¾–6″	¾–6″	½–8″	½–1″	¼–½″
MAX. INITIAL PRES. PSI	200	250	250	250	250	250	250	300
MAX. REDUCED PRES. PSI	15	80	125	125	15	125	125	180
MIN. REDUCED PRES. PSI	1	5	5	15	2	5	2.5	5
STEAM SERVICE								
WATER SERVICE							*	
AIR SERVICE							*	
GAS SERVICE								
OIL SERVICE								
SINGLE SEATED								
DOUBLE SEATED								
SPRING LOADED DIAPHRAGM								
WEIGHT & LEVER								
CONTINUOUS SERVICE								
DEAD END SERVICE								

*When specified, diaphragm must be changed from phosphor bronze to rubber.

No. 700

No. 740

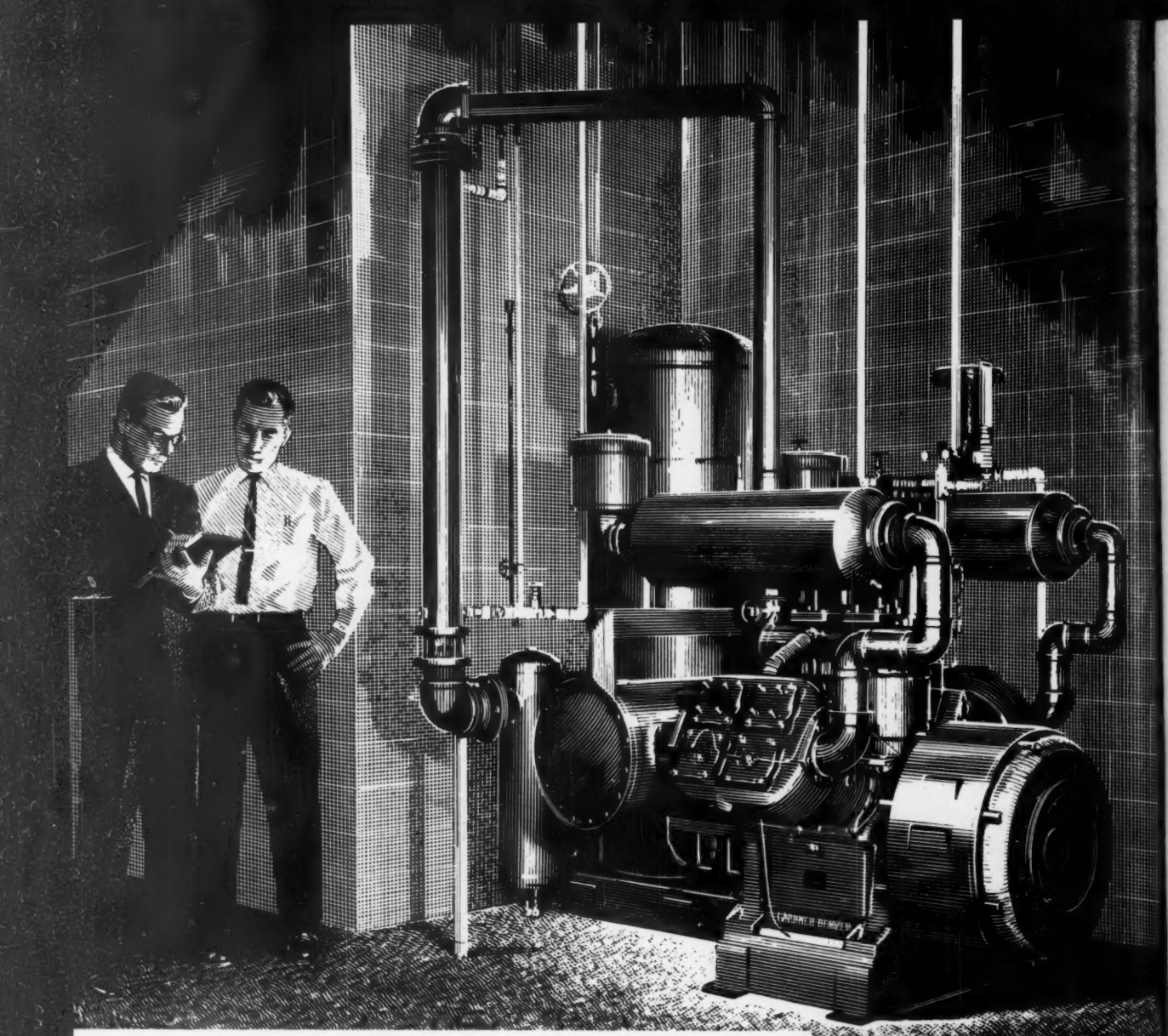
No. 750

No. 758

HOFFMAN SPECIALTY MFG. CORP.

1700 West 10th Street, Indianapolis 7, Indiana

Valves, Traps, Strainers, Pumps, Regulators • Sold by leading Wholesalers of Heating Equipment



"We pocket the difference"

The difference? Saving in floor space. No foundation cost. Quick and easy installation. The Gardner-Denver packaged air compressor goes right to work . . . provides a dependable supply of air for years. Want details? Request Bulletin WB-10.

Gardner-Denver Company, Quincy, Illinois—Offices in principal U.S., Canadian and Mexican cities
In Canada: Gardner-Denver Company (Canada), Ltd., 14 Curity Ave., Toronto 16, Ontario
International: Gardner-Denver International Division 233 Broadway, New York 7, N.Y.

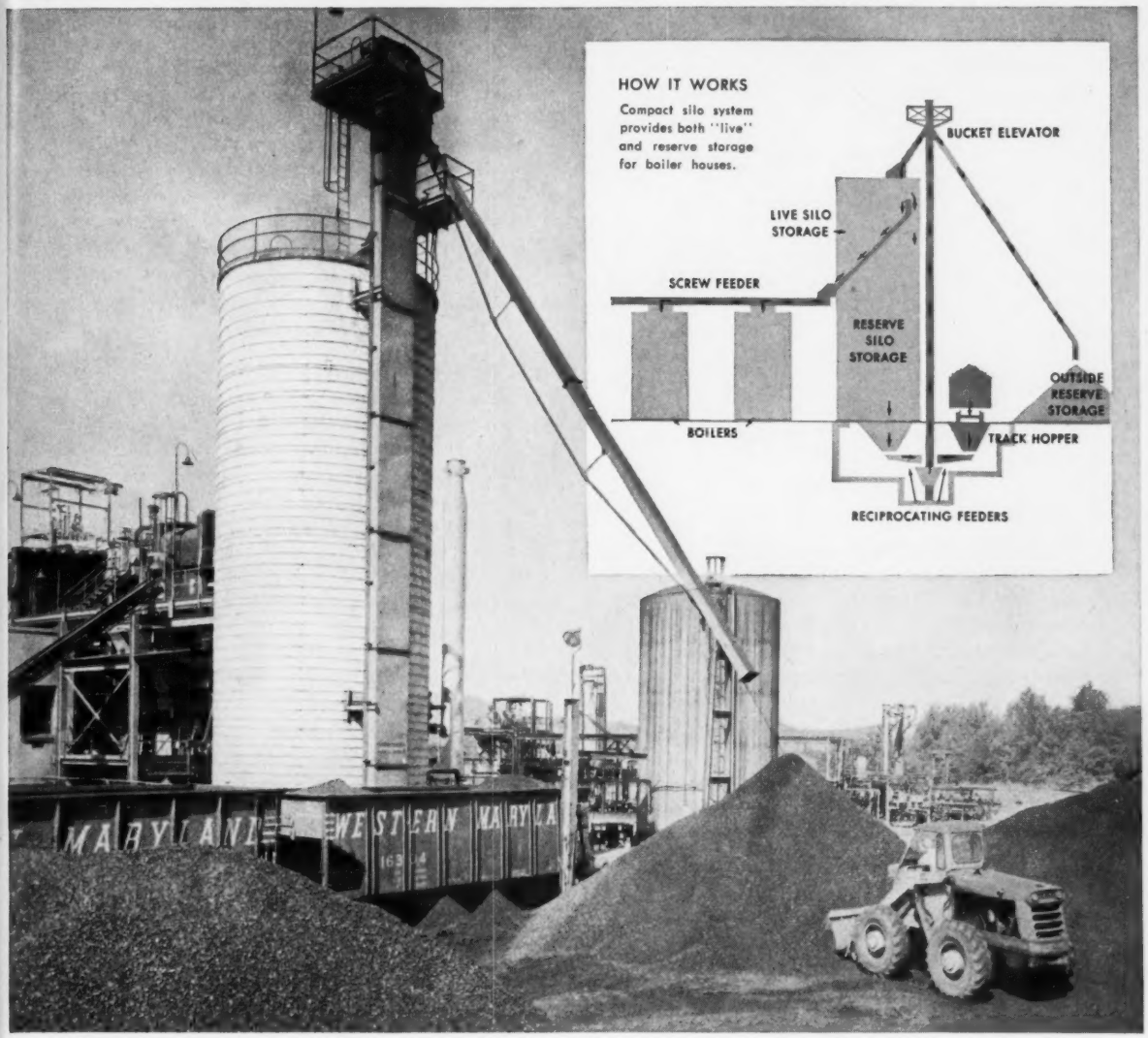
International Offices: Buenos Aires, Argentina; Artarmon, N.S.W. Australia; Brussels, Belgium; Rio de Janeiro, Brazil; Santiago, Chile; Barranquilla, Colombia; Lima, Peru; Ndola N. Rhodesia; Salisbury S. Rhodesia; Johannesburg, Transvaal

GARDNER-DENVER Since 1859

EQUIPMENT TODAY FOR THE CHALLENGE OF TOMORROW

GARDNER - DENVER

No boiler house too small to mechanize



Link-Belt coal-handling mechanization can effect new economies for the boiler house that consumes but a few tons of coal per hour. The same handling techniques that have brought significant savings and efficiencies to plants using thousands of tons per hour are applied with equal benefits to small installations.

Backed by virtually unlimited experience in this specialty, Link-Belt engineers can provide a coal-handling system exactly suited to your needs. Costs are kept to a minimum through the use of standardized components matched to capacity and layout requirements.

Next time you have a job that requires movement of materials or the mechanical transmission of power, call the Link-Belt office nearest you. If it involves coal-handling, ask for Power Plant Book 2410, or write LINK-BELT COMPANY, Dept. **P**, Prudential Plaza, Chicago 1, Ill.

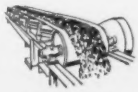
15,384

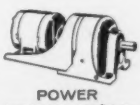
LINK-BELT

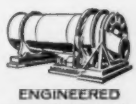
Basic products and engineering for industry's basic work

BEARINGS

CHAINS AND SPROCKETS


CONVEYING EQUIPMENT


POWER TRANSMISSION MACHINERY


ENGINEERED (PROCESSING) EQUIPMENT

Powerscope . . . A selective look at

TVA boosts target

TVA's newest plant, scheduled for fall 1965 start, has boosted size and steam conditions. The plant will be near the town of Edgemoor on the Clinch River in northeast Tennessee. Unit rating: 900-mw with 950-mw maximum capability. Steam conditions will be 3500 psig and 1000/1000 F. The turbine will be a cross-compound unit with h-p shaft turning at 3600 rpm and the l-p shaft at 1800 rpm. Throttle steam flow: 6,435,000 lb per hr. General Electric Company will build the turbine and Combustion Engineering, Inc will build the steam generator. Present TVA capacity is 11,885 mw with 2559 mw under construction. The Edgemoor plant will raise system capacity to 15,345 mw in the fall of 1965.

New mark in MHD

The Avco-Everett Research Laboratory has announced the generation of 205 kw for 10 seconds by their experimental magnetohydrodynamic generator. Unit is expected to produce over 500 kw after further work. The generator burns a mixture of kerosene or alcohol and oxygen seeded with powdered potassium salts to make an electrically conducting plasma. The plasma enters the generator at about 5000 F. Work is sponsored by 12 electric utilities, initiated by the American Electric Power Service Corporation.

Reusing water from sewage

Dow Chemical Company has a contract with the U. S. Public Health Service to investigate the use of activated carbon in water treatment. The 1-year research program will evaluate these agents for purifying municipal waste water. Right now, water is reused in some areas and the practice will have to extend to the most densely populated areas to combat increasing water shortages. Growing amounts of biologically undegradeable organic materials are discharging into the nation's waterways. Physical-chemical principles have to be found to remove these contaminants—adsorption and oxidation seem to offer promise, but economic feasibility is the main question. Research will be carried on in Midland, Michigan.

Trial by fire

Fire resistance of inorganic Class H transformer insulation was proven in a drastic test. A 1000-kva open dry type unit built by General Electric Company was shipped by truck. A tire caught fire and ignited highly combustible material loaded with the transformer on the truck. The fire burned for six hours before two fire-fighting companies got it under control. The truck and combustibles were destroyed, and the transformer had its steel-panel housing, core and coil structures buckled—but the latter did not catch fire. Temperature indicator registered its maximum of 300 C. Without repairs the unit passed standard high-potential and induced-voltage tests.

Most-efficient plant scheduled

Indiana & Michigan Electric Company of the American Electric Power System has scheduled a 580-mw unit for the Tanners Creek Plant at Lawrenceburg, Ind. Work will start this summer and be completed by spring of 1964. This fourth unit will have a heat rate of about 8500 Btu per kwhr and will raise plant capacity to 1105 mw, at a cost of $73 million. Concurrent construction includes 186 circuit-miles of 345-kv transmission line.

Germany's first gas-fired plant

West Germany's first power station to be fired by natural gas will be ready for operation by spring of '63. The plant at Landsbergen on the River Weser, owned by the Preussische Eelektrizitaets GMBH, will get 16-billion cu ft of gas annually from the Erdgas Verkaufs GMBH. First two 150-mw units will get their gas through a 35-mile pipeline. (*McGraw-Hill World News*)

Soviet transmission line

The U.S.S.R. plans to place a 293-mile 800-kv direct-current transmission line in service this year. Line will carry energy from the Stalingrad hydro station to the Donets coal basin. The overhead double line is expected to carry 4-billion kwhr annually. (*McGraw-Hill World News*)

Four Corners Plant takes shape

Future Four Corners Plant of the Arizona Public Service Company held a ground-breaking ceremony on March 10th. The outdoor plant will have two 175-mw units ready for operation in late spring of 1963. Built on the Navajo Reservation in northeast Arizona, the plant will have a 1200-acre artificial lake for cooling-water supply. Water for the lake will be pumped from the San Juan River, five miles away. Two pumps rated 15,000 gpm each will be driven by 2000-hp motors. Initial

this month's power-field happenings

B G A SKROTZKI, Associate Editor

filling of the lake will take 394 days; pumping starts in October '61. The lake is backed up behind a 6800-ft earth-fill dam. (*McGraw-Hill World News*)

In "cool" Kuwait

The Arab State of Kuwait on the Persian Gulf has ordered 3000 room air conditioners from the Westinghouse Electric Corporation. This will give Kuwait one air conditioner for every 16 persons in the country. The U.S. comes next in world conditioner statistics: one for every 23 persons. Kuwait has temperatures over 100 F most of the summer, an annual rainfall of 5 in. Since 1950, Kuwait has been buying 2000 American-made room air conditioners annually. The latest batch: 240-v 50-cycle units designed for continuous operation. They will deliver 80-F air at less than 50% humidity, with outdoor temperatures of 122 F. Relative humidities average 84% and average temperatures range from 94 F in August to 55 F in January. Each air conditioner is rated at 13,000 Btu per hr, compared to required minimum of 12,250.

Swedish generation record

Total electric-energy generation rose by 8%—to 35,100 million kwhr—in 1960 in Sweden. Of this total, 89% was generated by hydroelectric plants. In comparison, consumption including exports was 28,100-million kwhr. Total industrial consumption totaled 18,000-million kwhr.

Automatic coal handling

The Kammer Plant near Moundsville, W. Va., jointly owned by Ohio Power Company and Ormet Corporation, an aluminum company, stands within half a mile of a vein of coal. Hanna Coal Company runs the mine with the Kammer Plant as the sole customer. A 60-in. belt conveyor carries coal from mine head and transfers it to a central conveyor station in the Kammer coalyard. Secondary conveyors transfer it to other yard areas. Two 24-in. conveyors deliver raw coal to the crushing station and then automatically to the bunkers —the automatic conveyor system anticipates a future char plant. Nine continuous integrating conveyor scales built by Merrick Scale Mfg Co check tonnages delivered to parts of the system. Kammer burns coal at a rate of 2-million tons yearly. The scales have a specified accuracy of ½%, and are tested once a week with a calibrated roller test chain. The coal-handling system can be run from the plant's central control room.

New college course

University of Wisconsin now holds a unique course in Solar Energy Technology, offered as a regular academic credit course for seniors and graduates in chemical and mechanical engineering. The course covers basic concepts, availability, collecting solar radiation, application to house heating and cooling, distillation of sea water, powering space vehicles and other aspects.

African hydro plant

Kaiser Engineers and Constructors Inc has a $10.6-million contract with the government of Ghana to procure engineering, equipment and construction inspection of the Volta River hydroelectric plant. The dam and plant will have an ultimate capacity of 896 mw. Present plans call for 516 mw by 1965. The project includes a 500-mile transmission network to Southern Ghana. (*McGraw-Hill World News*)

Gas-turbine compressor drive

The United Fuel Gas Company, Charleston, W.Va., has ordered a gas-turbine-driven centrifugal gas-compressor unit from Solar Aircraft Company. The unit will be put in a natural-gas pipeline compressor station at Spencer, W.Va. An 1100-hp gas turbine drives the compressor at speeds from 15,000 to 30,000 rpm, eliminating need for reduction gearing. The gas compressor has interchangeable wheels covering a wide range of compression ratios and horsepowers to meet changing conditions. Unit weighs 9000 lb.

Natural-gas fuel cell

Northern Natural Gas Company and the Houdry Process Corporation have joined forces in developing a natural-gas fuel cell. The research will be carried on at Houdry's Linwood Laboratories where fundamental investigations have been under way for some time. The sponsors hope to produce electric energy in homes and factories at less than current costs. The catalyst is the critical part of the fuel cell—now claimed to operate at twice the efficiency of conventional power plants. (*McGraw-Hill World News*)

Reds plan wireless research

The Ukranian Academy of Sciences is undertaking a research program of wireless transmission of electric energy by radio beams. Other possible applications: powering electric tractors in the field, rock breaking, polymerization processes.

Compressed Air Data You should have about damage caused by Water, Vapors, Acid fumes and Abrasives in the Air System

A study and discussion of compressed air and its inherent properties which cause corrosion, contamination, abrasion and freezing of pneumatic equipment are covered in 16-page brochure "*Moisture Control.*"

Now in its 26th printing, the brochure explains how the unique, low-cost Van-Air method extracts water. vapors, acid fumes and abrasives which normally flow past aftercooler and receiver—how these elements corrode pneumatic equipment and controls—damage products in process—contaminate exposed solutions.

The method (which operates for *less than ONE-CENT per 18,000 cu. ft.*) requires no heat or power—no regeneration—delivers air dry, clean, sterile and non-toxic. Now used in hundreds of different applications in all types of plants—large and small. The method can treat any volume of compressor output from minimal air for smallest instrument, gage, tool, etc. to total air for entire plant. It has no capacity limit. Ask for brochure—*free on request.*

VAN PRODUCTS CO.• MFRS.

5776 SWANVILLE ROAD, ERIE, PA.

circle 318 on Reader Service card, p 103

Powerscope

Begins on page 162

Thermoelectric generator goes industrial

Dallas (*McGraw-Hill World News*) Westinghouse Electric Corp has delivered a 100-w thermoelectric generator to North Illinois Gas Co for use at a remote pipeline pumping station. It will provide cathodic protection and charge batteries for microwave relay system.

Unit consists of two 50-w sections stacked one on the other. Its output is 11 v at 10-amp dc. Static converter operating at about 88% efficiency changes output to 48 v at 2.1-amp dc.

This is one of the first industrial applications of thermoelectric generators. Northern Illinois plans research with the unit to investigate additional applications.

Sludge fuels German boilers

Bonn (*McGraw-Hill World News*) The Karnap Power Station which feeds into the central Rheinische-Westfaelischen Elektrizitaetswerke network daily uses 1700 tons of dried sludge to fire its boilers. A successful method has been evolved for artificially drying settling-basin deposits. This year a full-size plant for dehydrating sludge deposited in company's settling basins may go up at Karnap Station.

RG&E headquarters feature "integrated environment"

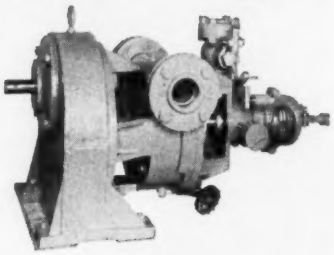
Three floors are completed in Rochester Gas and Electric Corp headquarters modernization program slated for completion sometime this year. Building features integrated lighting, heating and air conditioning.

An absorption refrigeration plant serves the entire building. It is located in the building's penthouse for minimum condenser- and chilled-water piping and pumping costs.

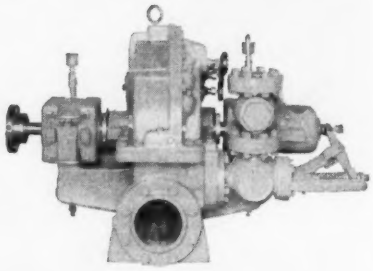
Air-conditioning and heating systems use much of the same equipment. The 3-pipe system serves large-coil-

CARLING

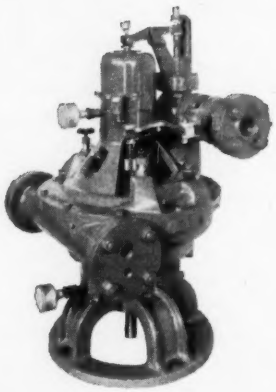
For 40 Years



the Quality Name



in TURBINES



WRITE FOR BULLETIN 20—C-3

CARLING TURBINE BLOWER CO.

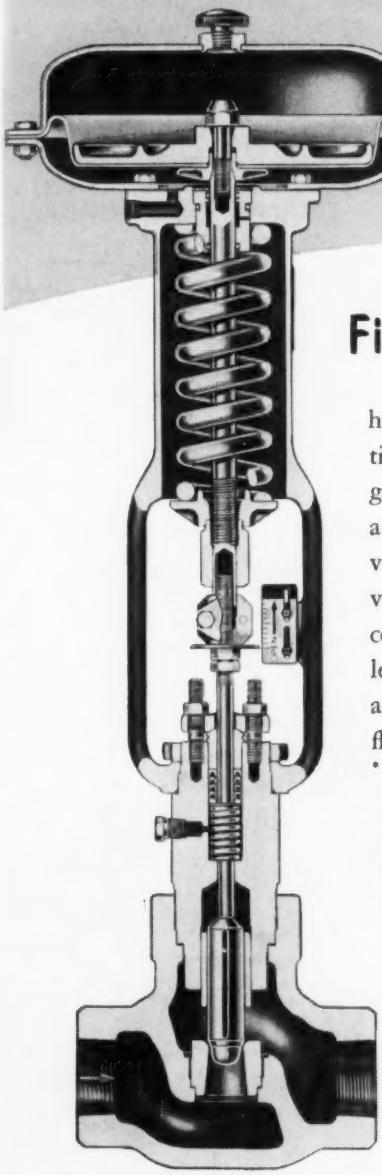
7 NEBRASKA ST., WORCESTER, MASSACHUSETTS

Representatives in Principal Cities

circle 319 on Reader Service card, p 103

NO WHIPPING... NO VIBRATION...

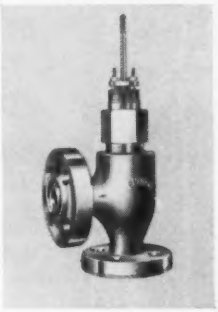
under high pressure drop conditions



Fisher High Pressure Cast Steel "D" Bodies

There's good reason why Fisher "D" bodies have become a standard item in oil and gas production control, and are also widely used in power plant, gas distribution and process industries. Here are just a few: The exclusive Fisher Micro-form Pup inner valve with rigid heavy duty extension guiding prevents whipping or vibration even under highest drop conditions. All "D" bodies are furnished with stainless steel trim and Stellite* on the seating surfaces at *no extra charge.* Can be supplied with screwed, flanged, socket or butt welding ends.

* Registered TM—HAYNES STELLITE



NOW AVAILABLE WITH INTEGRALLY CAST FLANGES

DESIGN "D" AND "DA" BODY AND ORIFICE SIZES

Size, Inches	Body End Connection	Body Pattern	Maximum Working Pressure	Orifice Size, Inches
½, ¾	Screwed	"D" Globe	3600 psi	¼, ⅜, ½
1				¼, ⅜, ½, ¾
1½, 2				¼, ⅜, ½, ¾, 1
1	1500 lb. ASA Flanged			¼, ⅜, ½, ¾
2				¼, ⅜, ½, ¾, 1
1	Screwed or 2500 lb. ASA Flanged	"D" Globe	6000 psi	¼, ⅜, ½, ¾
2*				¼, ⅜, ½, ¾, 1
1	Screwed or 1500 lb. ASA Flanged	"DA" Angle	3600 psi	¼, ⅜, ½, ¾
2				¼, ⅜, ½, ¾, 1
1	Screwed or 2500 lb. ASA Flanged	"DA" Angle	6000 psi	¼, ⅜, ½, ¾
2*				¼, ⅜, ½, ¾, 1

*Also available with 5,000 lb. and 10,000 lb. API flanges.

TYPE 667-D

Write today for further information

IF IT FLOWS THROUGH PIPE ANYWHERE IN THE WORLD . . . CHANCES ARE IT'S CONTROLLED BY . . .

FISHER GOVERNOR COMPANY

Marshalltown, Iowa / Woodstock, Ontario / Rochester, England

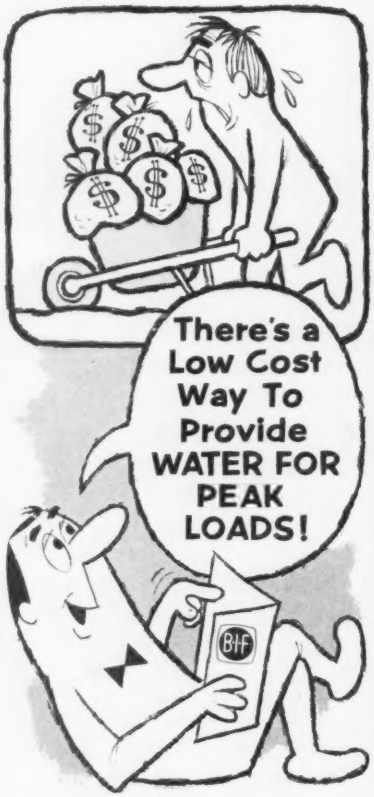
BUTTERFLY VALVE DIVISION: CONTINENTAL EQUIP. CO., CORAOPOLIS, PA.

FISHER® Controls

SINCE 1880

For more facts circle 320 on Reader Service card, p 103

B·I·F POSITIVE CONTROL OF MATERIALS FLOW



Delaying needed water filtration expansion because of high costs? Want to know how to meet peak load demands at a fraction of the cost normally required? B-I-F's new, low cost filtration system, built around performance-proved Vacuum Diatomite Filters, provides building-block flexibility . . . allows you to expand system . . . economically . . . as demands increase.

Free Facts

From its wide line of compatible components, B-I-F will provide a coordinated system to meet your specific peak load requirement. If you want water purer than sand filters can provide, at a low cost that will amaze you, request free facts today!

B·I·F Industries

BUILDERS-PROVIDENCE • PROPORTIONEERS • OMEGA
354 HARRIS AVENUE, PROVIDENCE 1, RHODE ISLAND

circle 321 on Reader Service card, p 103

Powerscope

Begins on page 162

capacity induction units and provides hot or chilled water as required.

The lighting system warms the space it illuminates, virtually providing all heating. A high-pressure dual-duct air system reduces excessive heat in internal areas.

TVA may operate Memphis steam plant

Memphis (*McGraw-Hill World News*) Memphis Utilities Committee, appointed by City Commission to study phases of Memphis Light, Gas & Water Div operation, recommended that the Tennessee Valley Authority take over operation of city's electric-generating plant. Memphis could buy its power from TVA. This would put the city in a position to offer cheaper power to industry.

If long-term agreement cannot be reached with TVA, committee said, electric rates would have to be increased from 5 to 20% if Division is to carry out proposed expenditure of $45 million in next five years. Division might obtain its future power-supply requirements from TVA in addition to the generating capability of Thomas H Aller. Steam Generating plant if the long-term contract could not be negotiated.

Other alternative would be to build additional generating units at Memphis plant—requiring still further electric rate rise.

With its own electric-generating station, committee reports, Memphis cannot produce and sell electric power at price comparable to Chattanooga, Knoxville and Nashville whose total requirements are supplied by TVA. Memphis rates are higher by about 16 to 20% for residential service, 36 to 60% for commercial service and 36% for industrial service.

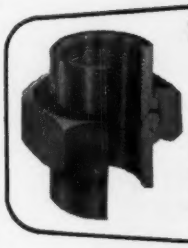
Aswan Dam project moves ahead

Drafts for the Aswan Dam and power plant in the U.A.R. are expected to be completed in the U.S.S.R. by the middle of this year, says Nikolai Malyshev, head of the group of Soviet engineers working on the plans. One

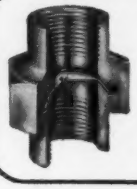
Catawissa
PERFECT SEAL
Unions

HOT FORGED from solid, rectangular steel bars, designed and produced for dependable, long-life service under the severest piping conditions!

A TYPE FOR EVERY USE!
FOR ALL PRESSURES!
FOR ALL TEMPERATURES!



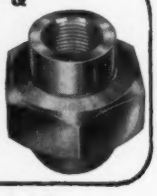
Standard & Double Extra Heavy
UNIONS
Available with screwed or socket weld ends. 3000-lb. sizes ⅛" to 3"; 6000-lb. sizes ⅛" to 2".



GASKETLESS
CUP-ORIFICE UNIONS
Choice of stainless or carbon steel cup-type plate. 3000-lb. service.

MALE & FEMALE UNIONS
With steel-to-steel, bronze-to-steel, stainless steel-to-steel or orifice seats. 3000-lb. service only.

FULL STAINLESS & FULL ALLOY STEEL UNIONS
With screwed or socket weld ends. 3000-lb. and 8000-lb. service.



Write for Catalog 60
Showing the Complete Catawissa line of Perfect Seal Products

CATAWISSA VALVE & FITTINGS COMPANY
CATAWISSA, PENNA.

circle 322 on Reader Service card, p 103

A breakthrough in fan design for induced and forced draft or cooling

- High efficiency over the whole range of regulation.
- Continuous regulation from 0 to maximum output at constant speed.
- Regulates automatically when connected to corresponding boiler control system. Servo-motors of any make may be used.
- Short overall length.

NOVENCO INC
69 Fifth Ave., New York 3, N. Y.
CHelsea 3-2314

NOVENCO INC. 69 Fifth Ave., New York 3, N. Y.
☐ Please send literature
☐ Send information on following boiler capacity .....
Name.....
Address.....
City..... State.....

For more facts circle 323 on Reader Service card, p 103

It's the "law"!

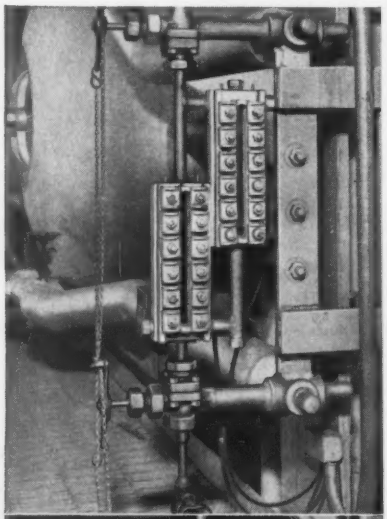
(ASME Power Boiler Code)

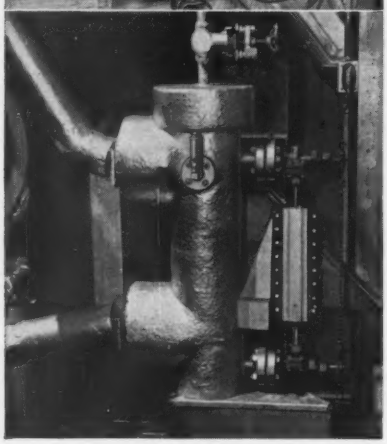
Reliance reminds you of an important rule

Remember that the Boiler Code requires the use of *two water gages* per boiler on installations operating at 400 psi or over (Par. P-291). You can comply by using one of these combinations:

1. provide two water columns, one at each end of the drum – a gage on each.
2. one water column having two sets of gage connections; use "twin" gages.
3. one column at one drum end, and a direct-to-drum water gage assembly at the other.
4. two direct-to-drum assemblies, one on each end of the drum.
5. use one conventional gage, either direct-to-drum or on water column, and two manometric-type remote gages (the Reliance EYE-HYE) if operating over 900 psi. (Case No. 1155.)

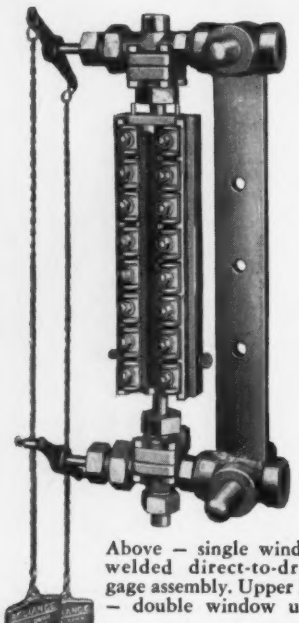
The combination you choose needs only to meet connection rules of the Code – besides, of course, the use of column and gage equipment of adequate capacity *and conforming to the general rules of the Code covering materials and welding.*





You can be sure of complete safety and Code conformance when you specify Reliance Water Column and Gage Equipment. It has been accepted as "standard" by boiler manufacturers and consultants for 75 years. Standard and custom-built products for every pressure range.

Check with your consultant, or call in the Reliance Representative for your area.



Above – single window welded direct-to-drum gage assembly. Upper left – double window unit.

THE RELIANCE GAUGE COLUMN CO. • 5902 Carnegie Avenue, Cleveland 3, Ohio

Reliance® BOILER SAFETY DEVICES

variant of the Aswan Hydroelectric Power Station might gradually introduce new turbines as demand increased. Final output of electricity is to reach about 10,000 million kwhr.

Hot oil bids to replace steam for plant heating

Dallas (*McGraw-Hill World News*) Shell Oil Company and Arkansas Fuel Oil Corporation plan to construct a gasoline plant using hot oil for heating in place of steam. This is expected to reduce installation costs.

Plant, to be located in North Rincon Field, Texas, will be capable of refrigerating oil and gas to —20 F and will use purchased electric power. Completion is scheduled for July of this year. Recovery output is expected to include 15,500 gal of propane, 14,000 gal of liquid petroleum gases and 7900 gal of gasoline daily.

NATO base gets sea-water converters

British Admiralty at the NATO base on Gibraltar have commissioned two 5-stage flash-evaporator sea-water converters. The units, designed by Cleaver-Brooks Special Products, will convert 150,000 gal of sea water into fresh water daily.

Only source of water for the base in the past was rainfall entrapment—and this was effective only four months out of the year.

New plant to help combat power shortage up north

(*McGraw-Hill World News*) Anchorage, Alaska City Council has voted to construct a natural-gas turbine-electric generating plant estimated to cost about $2 million. They're thinking of building the plant in several increments, the first to have a rated output of 6500 kw at 80 F and 7800 kw at 40 F or less.

Plant may be built within city or on Kenai peninsula near a natural-gas source. It would operate before the winter of 1962, when a power shortage would otherwise occur.

For more facts circle 324 on Reader Service card, p 103

circle 325 on Reader Service card, p 103 ➤

Recommendation: NORDBERG
After careful consideration of all facts by our committee studying power generation requirements, we selected Nordberg engines.
RWB-
NORDBERG
Dick Carlton

© 1960 N. M. CO.

P359-R

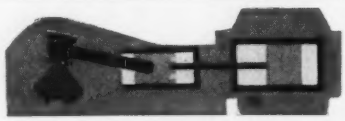
NORDBERG MANUFACTURING COMPANY · Milwaukee 1, Wisconsin

ATLANTA • CLEVELAND • DALLAS • DULUTH • HOUSTON • KANSAS CITY • MINNEAPOLIS • NEW ORLEANS • NEW YORK • ST. LOUIS
SAN FRANCISCO • TAMPA • WASHINGTON • TORONTO • VANCOUVER • JOHANNESBURG • LONDON • MEXICO, D. F.

WERE YOU APRIL-FOOLED BY THIS WORTHINGTON AD?

If not, you should have been. Here's why . . .

In the April issue of POWER, appearing April 1st, Worthington Corporation ran the above compressor ad on our back cover. This ad refers to "hidden values." To arouse interest, it contains one false value which was to be revealed in a small ad in the classified section of the same issue. The *correct* small "Answer" is shown here.



ANSWER

to Worthington Hidden Value Puzzle

The fictitious "hidden value" on the back cover is, of course, the "Full Floating Wrist Pin" in the piston. This construction is found only on light duty compressors with single acting cylinder construction.

Because all Worthington horizontal compressors are heavy duty machines, they are built with the crankshaft, connecting rod and crosshead linkage system illustrated above. It changes rotary shaft motion to linear piston motion without side thrusts on the cylinder walls. Thus wear is reduced and compressor life increased. Worthington Corporation.

What happened? The classified department at POWER ran an "Answer" which referred to another ad in the campaign. Result? If you were diligent enough to search out the hidden value and tried to confirm it by looking up the answer, you must have been totally confused!

This might be written off as an inadvertent April Foolishment, and our friends at Worthington have already done so. But when we make an error, no matter how inadvertent, our consciences can't rest until we have done all we can to correct it. Light as our tone may be, that is the serious purpose of this message from . . .

Power

Calendar

May 7-10 — American Institute of Chemical Engineers, Meeting, Sheraton-Cleveland Hotel, Cleveland, Ohio. Details: AIChE, 25 W 45th St, New York 36, N. Y.

May 7-11—American Society of Mechanical Engineers, Hydraulics Conference, Queen Elizabeth Hotel, Montreal, Can. Details: ASME Meetings Dept, 29 W 39th St, New York 18, N. Y.

May 8-9 — American Society of Mechanical Engineers, Lubrication Symposium, Deauville Hotel, Miami Beach, Fla. Details: ASME Meetings Dept, 29 W 39th St, New York 18, N. Y.

May 8-10 — Instrument Society of America, 4th National Power Instrumentation Symposium, LaSalle Hotel, Chicago, Ill. Details: Meetings Manager, ISA, 313 Sixth Ave, Pittsburgh 22, Pa.

May 9-11—Annual Western Joint Computer Conference, National Joint Computer Committee—Institute of Radio Engineers, American Institute of Electrical Engineers, Association for Computing Machinery—Ambassador Hotel, Los Angeles, Calif. Details: Dr W F Bauer, Thompson Ramo Wooldridge, Inc, Ramo-Wooldridge Div, 8433 Fallbrook Ave, Canoga Park, Calif.

May 10-12—Pulp and Paper Instrumentation Symposium, sponsored by ISA, TAPPI, Northland Hotel, Green Bay, Wis. Details: Meetings Services Dept, ISA, 313 Sixth Ave., Pittsburgh 22, Pa.

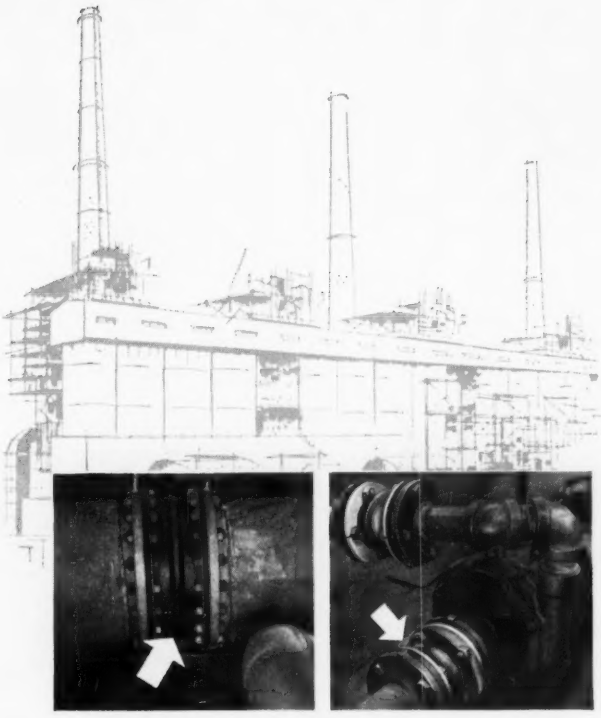
May 10-12—Society for Experimental Stress Analysis, Spring Meeting, Benjamin Franklin Hotel, Philadelphia, Pa. Details: SESA, 21 Bridge Square, Westport, Conn.

May 21-23—Fluid Controls Institute, Inc, Annual Meeting, The Cloister, Sea Island, Ga. Details: FCI, Box 667, Pompano Beach, Fla.

May 22-24—10th National Telemetering Conference, sponsored

ENGINEERED PRODUCTS

for Plant Maintenance



Typical installations show Garlock Rubber Expansion Joints on a 26" vacuum condenser inlet (left) and 2½" suction and discharge pipes. Garlock furnishes standard joints from ¾" to 72" in pipe diameter, and in all shapes.

Install Garlock Rubber Expansion Joints. It's good piping practice; here is why:

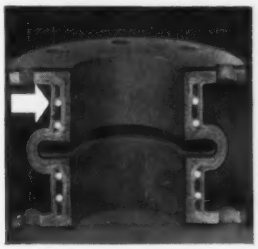
1. Prevent stresses. Piping systems expand and contract with temperature changes. Garlock Expansion Joints act as a "breather" . . . compensate for expansion and contraction.

2. Eliminate vibration and noise. Pumps, compressors, engines, and pressure surges in pipe lines create vibration and objectionable noises. Garlock Rubber Expansion Joints act as an absorbent cushion . . . reduce vibration and insulate against transfer of noise to other parts of the building.

3. Compensate for misalignment. Piping and mechanical equipment often move out of normal alignment during operation due to wear, load stresses, or settling of buildings. Garlock Rubber Expansion Joints compensate for this and prevent possible breakdowns of equipment. They also make installation easier since alignment of piping and equipment need not be as accurate when expansion joints are used.

4. Reduce flange breakage. Undue stress caused by misalignment, vibration, expansion or contraction of piping or equipment, will break the metal connecting flanges. Garlock Rubber Expansion Joints relieve such stresses.

Offer many application advantages. Garlock Rubber Expansion Joints outlive metal ones; do not crack, corrode, lose shape, or require gaskets. The sturdy construction of Garlock Rubber Expansion Joints results in satisfactory service where pressures are as high as 150 p.s.i., temperatures to 180°F.



Expansion joints are also available for service up to 450°F. In the photo of the joint cut in half, the arrow points to a steel reinforcing ring which, when varied in number with the joint size, provides the extra strength needed for the most severe applications.

For more data, call the nearest of the 26 Garlock sales offices and warehouses throughout the U.S. and Canada. Or, write for Catalog AD-137, Garlock Inc., Palmyra, N.Y.

GARLOCK

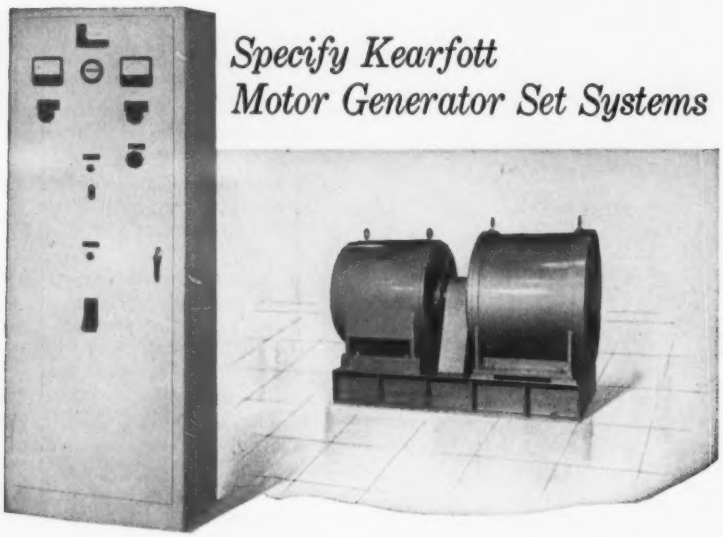
Canadian Div.: Garlock of Canada Ltd.
Plastics Div.: United States Gasket Company.

Order from the Garlock 2,000 . . . two thousand different styles of Packings, Gaskets, Seals, Molded and Extruded Rubber, Plastic Products.

*DuPont Trademark

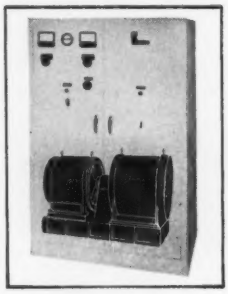
For more facts circle 326 on Reader Service card, p 103

FOR PRECISE 400-CYCLE POWER



Specify Kearfott Motor Generator Set Systems

Kearfott 60-to-400 cycle motor generator frequency converters are in active use wherever precise 400-cycle power must be supplied . . . including laboratories and in such other representative applications as production testing, high speed tool operation and ground support. These generator systems, which consist of a 60 cycle synchronous motor and a 400 cycle generator, can be supplied with controls and generator as an integral, compact unit—or with controls and generator separately located.



PERFORMANCE SPECIFICATIONS

Frequency: 400 cycles under any rated load condition with 60 cycle input.

Voltage Regulation: Within ±1% of rated voltage when (1) load varies between no-load and 125% of rated load, and/or (2) load power factor varies between 0.8 lagging and unity, and/or (3) equipment temperature varies after approximately 10 minutes' operation.

Voltage Recovery: When rated load is suddenly applied or removed, voltage will return to and remain within regulating band within 0.25 seconds.

Voltage Adjustment: Continuously adjustable to ±10% of rated value.

Deviation Factor: Maximum 4% between no load and full load.

Overload: Equipment delivers 125% of rated load for 2 hours.

Amplitude Modulation: Maximum 1% of peak-to-peak voltage at any load between no load and full load, at any power factor between 0.8 lagging and unity.

Frequency Modulation: Maximum 0.5% at any load from no load to 125% of rated load.

GP

KEARFOTT DIVISION
GENERAL PRECISION, INC.

Little Falls, New Jersey

Sales and Engineering Offices: 1500 Main Ave., Clifton, N. J.
Midwest Office: 23 W. Calendar Ave., La Grange, Ill.
South Central Office: 6211 Denton Drive, Dallas, Texas
West Coast Office: 253 N. Vinedo Avenue, Pasadena, Calif.

Calendar

Begins on page 170

by ISA, AIEE, ARS, IAS, IRE. Sheraton Chicago Hotel, Chicago, Ill. Details: Meetings Services Dept, ISA, 313 Sixth Ave, Pittsburgh 22, Pa.

May 22-25 — American Society of Mechanical Engineers, Design Engineering Conference & Show. Cobo Hall Hotel, Detroit, Mich. Details: ASME Meetings Dept, 29 W 39th St, New York 18, N. Y.

June 6-8—Instrument Society of America, Summer Instrument-Automation Conference and Exhibit, Royal York Hotel, Queen Elizabeth Hall, Toronto, Ont., Can. Details: Meetings Manager, ISA, 313 Sixth Ave, Pittsburgh 22, Pa.

June 6-8 — Annual Appalachian Underground Corrosion Course, W. Va. U, Morgantown, W. Va. Details: J Alm, 2 Gateway Ctr, Pittsburgh, Pa.

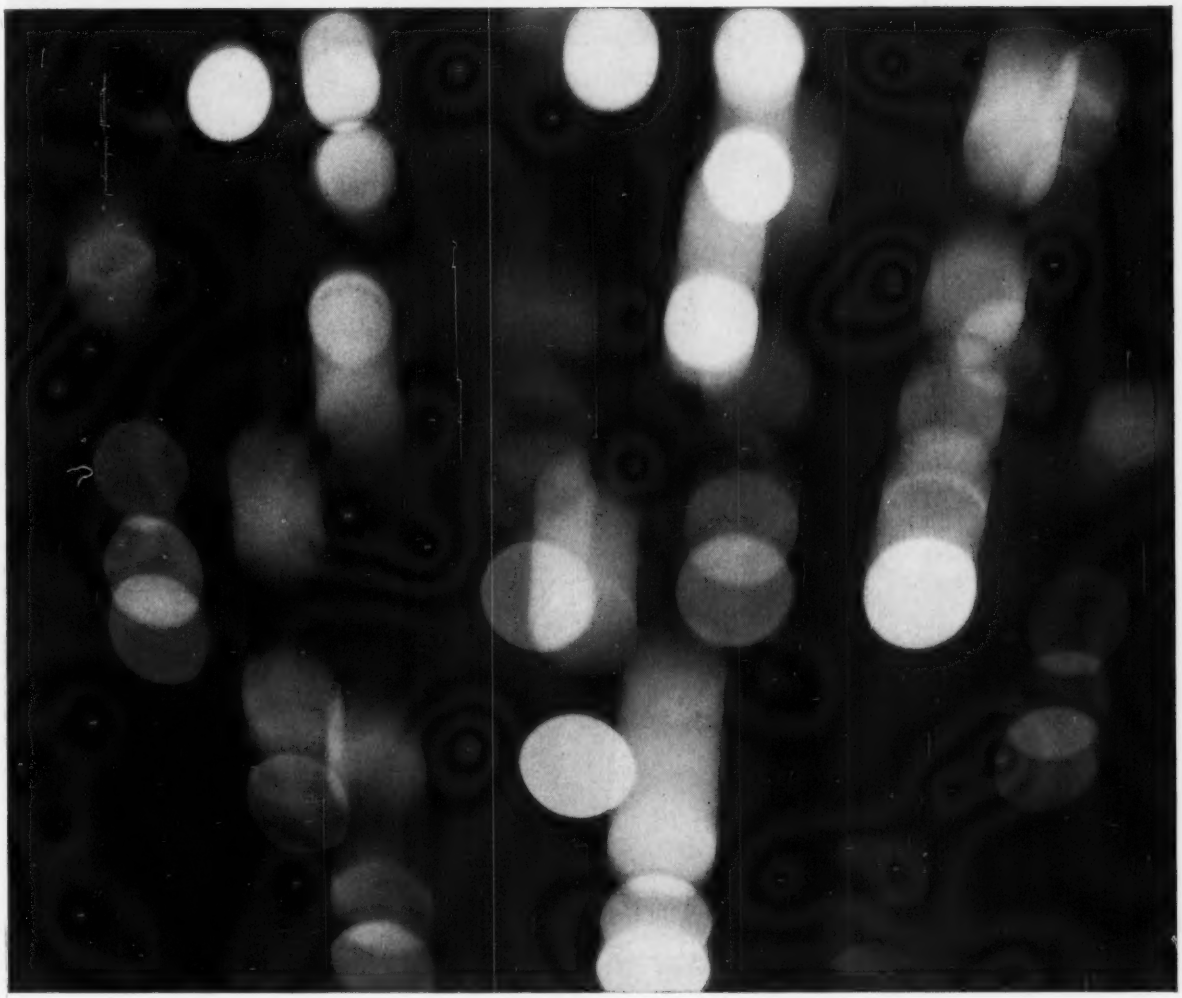
June 8-9 — National Electrical Manufacturers Assn, Western Conference, Biltmore Hotel, Los Angeles, Calif. Details: NEMA, 155 E 44th St, New York 17, N. Y.

June 11-15 — American Society of Mechanical Engineers, Summer Annual Meeting, Statler-Hilton Hotel, Los Angeles, Calif. Details: ASME Meetings Dept, 29 W 39th St, New York 18, N. Y.

June 12—Air Pollution Instrumentation Symposium, sponsored by ISA, APCA, Hotel Commodore, New York, N. Y. Details: Meetings Manager, ISA, 313 Sixth Ave, Pittsburgh 22, Pa.

June 12-15 — National District Heating Association, 52nd Annual Meeting, Wentworth - by - the - Sea, Portsmouth, N. H. Details: J F Collins Jr, NDHA, 827 N Euclid Ave, Pittsburgh 6, Pa.

June 14-16—Applied Mechanics Conference, Ill. Inst of Technology, Chicago, Ill. Details: ASME Meetings Dept, 29 W 39th St, New York 18, N. Y.



Corrosion on the Run . . . Cascading over a waterfall or tumbling from the sky, tiny droplets of water absorb gases from the atmosphere. While aerated water is pleasant to the taste and touch, it vigorously corrodes and destroys boiler tubes, industrial piping systems and processing equipment. Effective deaeration is the best answer to the removal of destructive gases such as oxygen and carbon dioxide. ● Over 75 years ago, Cochrane pioneered the first of many developments in this field with the introduction of the direct contact feedwater heater. Today, with the largest number of deaerator installations in the world, Cochrane continues to research and refine this important requirement of modern power and processing plants. This background is your assurance of proper recommendation and performance. In water conditioning . . . the name is Cochrane. Ask for literature on applications and types of deaerators. Write Cochrane Division, Crane Co. 3106 N. 17th Street. Philadelphia 32, Penna.

at the heart of home and industry

COCHRANE DIVISION **CRANE** WATER CONDITIONING

plumbing heating • air conditioning valves and piping electronic controls

For more facts circle 328 on Reader Service card, p 103

How SEVENeering with R/M eliminated costly packing replacement problem on revolving head spray machine

Switch to new R/M No. 363 Packing Rings increased packing life up to 500%

Poor packing life once was a major cause of a spray painting problem on the acoustical tile production-line at Wood Conversion Company, Cloquet, Minn. The packings in the revolving head spray machines required frequent takeup, were damaged by the water-soluble clay and latex paint, failed in 5-7 days.

In the search for better packings, Wood Conversion Company consulted Modern Distributors, Duluth, Minn., an authorized R/M distributor. R/M No. 363, a new braided asbestos packing with a neutral, graphite-free lubricant, recently introduced by R/M, was recommended. Following tests in its own plant, the company adopted this packing, and with outstanding results.

Packing life has increased as much as 500%, fewer adjustments are needed, shafts wear longer. To sum it up: An R/M packing that costs less than the one it replaced has not only solved a vexatious problem for Wood Conversion Company, but has also brought the big positive advantage of more profitable operations.

The company has been using R/M packings for a number of critical applications, all with complete success.

Call in your nearby authorized R/M packing distributor to help you solve your packing problems. R/M No. 363 may not be the answer in your case, but you can be sure he stocks the right packing to fill your requirements. Learn more about SEVENeering with R/M . . . ask your distributor for a copy of the new R/M Big 7 Packing Selection Chart today.

R/M's Big 7 Packing Types meet 95% of all packing needs, are sold exclusively through authorized R/M distributors

RAYBESTOS-MANHATTAN, INC.
BIG 7 PACKINGS
PACKING DIVISION, PASSAIC, N.J.
MECHANICAL PACKINGS AND GASKET MATERIALS

Appointments

William E Vannah

The Foxboro Company has appointed William E Vannah, former chief editor of *Control Engineering*, associate for advanced engineering. He will provide engineering and marketing guidance for advanced products and systems.

Vannah established the Dynamics and Control Lab of the Mechanical Enginering Dept while on the staff of MIT and worked in their Servomechanisms Research Lab.

An officer of the American Automatic Control Council, he is also an executive of the Automatic Control Div of ASME.

He originally joined Foxboro in 1948, went on to the McGraw-Hill Publishing Company in 1954. In addition to serving as chief editor of *Control Engineering* he was consulting editor to the Book Company.

Awards

H R Copson, International Nickel Company Research Lab: Whitney Award of National Assn of Corrosion Engineers. **K G Compton,** Bell Telephone Labs, Inc: Speller Award of NACE.

H G Andre

Henri G André, French scientist and inventor of the first practical rechargeable silver-zinc battery, received the Gaston Planté Medal and Prize of the Société Française des Electriciens. His silver-zinc battery is characterized by compactness and high energy.

André also holds the Ampère Medal of the Société, awarded for his achievements in electrochemistry, and the French Legion of Honor Croix de Chevalier.

A member of the Electrochemical Society, he has designed and developed experimental electric cars powered by silver-zinc batteries.

Retirements

H W Collins, assistant to the manager of system development for De-

Howard King, Compressor Supervisor (right) reports to Delmer Sullins, Plant Engineer, National Tank Company...

"This new air compressor taught us what 'attention-free' really means"

The Cooper-Bessemer DMR-2 Compressor shown was installed 7 months ago at National Tank Company, Tulsa. It has operated on a continuous schedule since then, delivering 757 cfm air at 125 psig pressure. According to Mr. Sullins, "This is really a reliable attention-free compressor. I like its automatic features and smooth performance."

When you plan compressed air facilities, it will pay you to investigate the new DMR line. These compact air compressors are completely equipped with integral motor-drive, inter-cooler and En-Tronic control. Available for 500 to 2000 cfm. Write for Bulletin 94. Experienced engineers of Cooper-Bessemer will help you plan for optimum efficiency. Call our nearest office.

Cooper Bessemer

GENERAL OFFICES: MOUNT VERNON, OHIO

COMPRESSORS: RECIPROCATING AND CENTRIFUGAL
ENGINES: GAS - DIESEL - GAS-DIESEL
JET-POWERED GAS TURBINES

For more facts circle 330 on Reader Service card, p 103

Good Pair to Know!

Chances are you won't have to look far to find a spot for one of these float-operated switches.

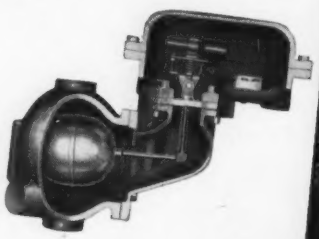
They have been specially developed by McDonnell to serve two broad fields of application. They answer a lot of operating problems that you may have thought could be handled only by make-shift or much more expensive equipment.

Dependable and time tested, they are just two of hundreds of products developed by McDonnell for liquid level or liquid flow control. When you choose from the complete McDonnell line it's good to know you draw on unmatched experience and know-how in this specialized field.

McDonnell No. 65
Explosion Proof Electric Controller

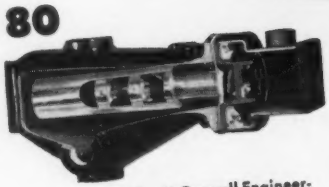
Underwriters' Listed for use in hazardous locations:
Class 1, Group C & D
Class 2, Group F & G

A float-operated switch for use under hazardous conditions, such as atmospheres containing butane, benzol, lacquer solvent, alcohols, acetone, coal and grain dust, etc. Can be furnished to make or break electric circuit at high- or low-level — to control motors, signal lamps, electric elements, etc. Suitable for internal pressures up to 40 psi.



Write for McDonnell Engineering Bulletin ERS-10 which discusses typical applications of No. 65, shows wiring diagrams for different patterns of operation.

McDonnell No. 80
High- or Low-Level Switch



Underwriters' Listed for use on oil tanks.

A float-operated three-terminal switch that can be used to provide high- or low-level alarm, or to start or stop a pump when level rises or falls. It makes possible reliable automatic control in place of gauge glass watching and manual control.

Write for McDonnell Engineering Bulletin ERS-9 which shows typical application of No. 80 on oil storage tanks, complete with wiring diagrams for draining or filling tanks, high- or low-level alarm, signal or cut-off.

Write for complete literature and engineering bulletins.

McDONNELL & MILLER, *Inc.*, 3506 N. Spaulding Ave., Chicago 18, Ill.

Doing One Thing Well

REG. U. S. PAT. OFF. SAFETY CONTROLS

Your Jobber Stocks Them

McDONNELL

BOILER WATER FEEDERS • LOW WATER FUEL CUT-OFFS • PUMP CONTROLLERS • RELIEF VALVES • FLOW SWITCHES • RELATED LIQUID LEVEL CONTROLS FOR TANKS, STILLS, AIR CONDITIONING SYSTEMS

Appointments

Begins on page 174

troit Edison Co, after 41 years. **W F Wetmore,** director of Detroit Edison Co's general-engineering dept, after 33 years.

Charles Edison

McGraw-Edison Company board chairman Charles Edison retired from the company on the first of this year. He will continue with the company as honorary chairman and consultant.

Edison, who is 70 years old, rounded out 47 years with McGraw-Edison and predecessor companies, McGraw Electric Co and Thomas A Edison, Inc. Former Governor of New Jersey, he is the son of Thomas A Edison.

Managers

SKF Industries, Inc: James R Miller, production manager. **Allis-Chalmers Mfg Co:** S M Austin, manager, water-conditioning products. **Brooks Instrument Co, Inc:** William C Quance, plant manager, Netherlands plant. **Hewitt-Robins, Inc:** C L Frost, manager, distributor sales.

General Electric Co: S R Sulis, manager, Instrument Product Planning; F W Newman, manager, Product Service; G E Lewis, manager of engineering, H-v Specialty Transformer Section; Dr P A Abetti, manager, Electrical Engineering Lab; P H Light, manager, Electric Utility Analytical Engineering; K J Morray, sales manager, Silicone Products Dept. **Electric Specialty Co:** H W Thode, general sales manager.

Engineer changes

Electro-Mech Corp: Anthony L Liccardi, chief engineer. **Computer Systems, Inc:** J M Nelson, W S Reaves, D J Berkery; applications-engineering staff. **General Electric Co:** D P Timo, manager, turbine-structural - engineering component; M A Eggenberger, turbine-control-systems engineer. **Fafnir Bearing Co:** R P Remorenko, assistant chief research engineer.

Shell Tellus Oils are refined and formulated to meet exacting hydraulic service requirements, such as in this forming machine.

PHOTO COURTESY ATLANTIC PLASTICS INC., STAMFORD, CONNECTICUT

BULLETIN:

Shell provides a quick 6-point check list for hydraulic oils: Use it to pick the right oil for your needs

Selecting the proper hydraulic fluid for your equipment can be one of your most important decisions. And it can pay off in many ways. Less down time. Lower cost per unit. Longer equipment life.

Here are six bench marks to help you pick the best hydraulic oil for your plant requirements.

1. Does it have good oxidation stability? Oxidized hydraulic oil can form gums, lacquers and other deposits which may foul moving parts. Shell Tellus Oils are carefully refined to remove unstable, sludge-forming components, then fortified with a Shell-developed oxidation inhibitor.

2. Will it resist foaming and emulsification? Pump chatter and erratic operation are often the result of pump cavitation, brought on by oil foaming. Tellus® Oils contain powerful additives to help prevent foaming.

They also contain a selected inhibitor to combat effects of moisture that might be in the system.

3. Does it fight rust and corrosion? It is difficult to exclude all moisture from a hydraulic system. And moisture can form troublesome rust. Shell Tellus Oils have been carefully compounded to resist corrosion.

4. What are its lubrication qualities in continuous service? Shell Tellus Oils form a clinging, oily film on mating metal surfaces. This maintains a constant guard against wear.

5. How does it react to temperature changes? This is a key factor in the performance of hydraulic equipment. Careful selection of the proper viscosity grade of Tellus assures satisfactory operation of your system over its entire temperature range.

6. Is it available in several viscosity grades? Shell Tellus Oils are available in a broad range of viscosity grades. There's a special grade for virtually every hydraulic requirement.

Ask your Shell Industrial Products Representative for facts on Tellus Oils. Or write: Shell Oil Co., 50 West 50th St., New York 20, N. Y.

A message to manufacturers of hydraulic equipment

There is a Shell Tellus Oil suited for your equipment.

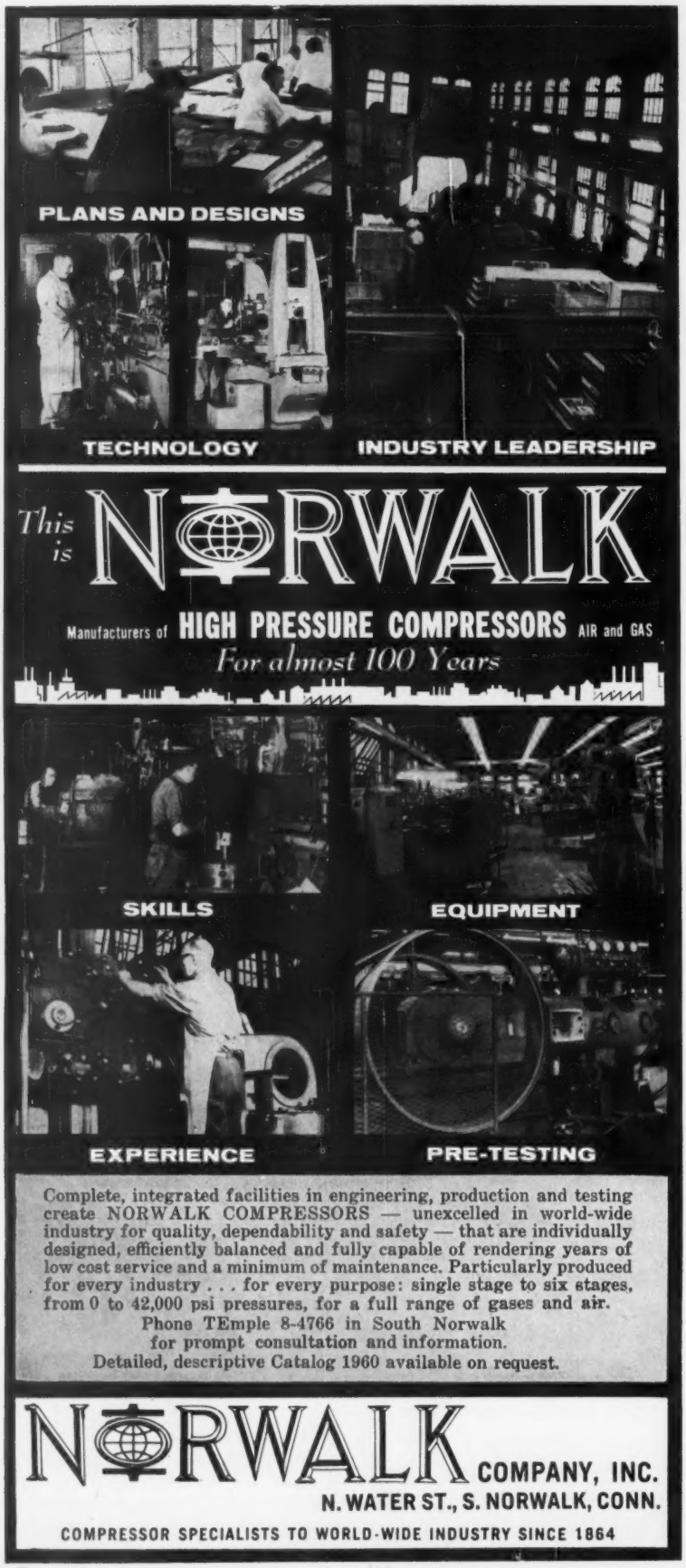
1. Your customers can get Tellus Oils at Shell depots everywhere. Readily available throughout the world.

2. Quality is consistently high. Tellus always delivers top performance.

SHELL

A BULLETIN FROM SHELL
—where 1,997 scientists are working to provide better products for industry

For more facts circle 332 on Reader Service card, p 103


PLANS AND DESIGNS
TECHNOLOGY
INDUSTRY LEADERSHIP
This is NORWALK
Manufacturers of HIGH PRESSURE COMPRESSORS AIR and GAS
For almost 100 Years
SKILLS
EQUIPMENT
EXPERIENCE
PRE-TESTING
Complete, integrated facilities in engineering, production and testing create NORWALK COMPRESSORS — unexcelled in world-wide industry for quality, dependability and safety — that are individually designed, efficiently balanced and fully capable of rendering years of low cost service and a minimum of maintenance. Particularly produced for every industry . . . for every purpose: single stage to six stages, from 0 to 42,000 psi pressures, for a full range of gases and air.
Phone TEmple 8-4766 in South Norwalk
for prompt consultation and information.
Detailed, descriptive Catalog 1960 available on request.
NORWALK COMPANY, INC.
N. WATER ST., S. NORWALK, CONN.
COMPRESSOR SPECIALISTS TO WORLD-WIDE INDUSTRY SINCE 1864

Bookshelf

Engineering Thermodynamics. *By D B Spalding, professor of heat transfer and E H Cole, Lecturer, both of Mechanical Engineering Dept, City and Guilds College, Imperial College of Science and Technology, University of London. 375 pp, illust, tables, cloth, $8.50. McGraw-Hill Book Company, 330 W 42nd Street, New York 36, N. Y.*

Fundamentals rather than applications are stressed, but the fundamentals are applied to show how they may be used to solve practical engineering problems.

Book falls into four main parts. Chapters 2 to 5 define the basic terms of thermo and give the properties of systems. Chapters 6 to 9 cover the First Law, energy, properties of the pure substance and steady-flow conditions. Chapters 10 to 13 include engines, the Second Law, absolute temperature scale and entropy.

Chapters 14 to 16 discuss ideal gases, gas mixtures, fuels and combustion. The book features a wide variety of examples.

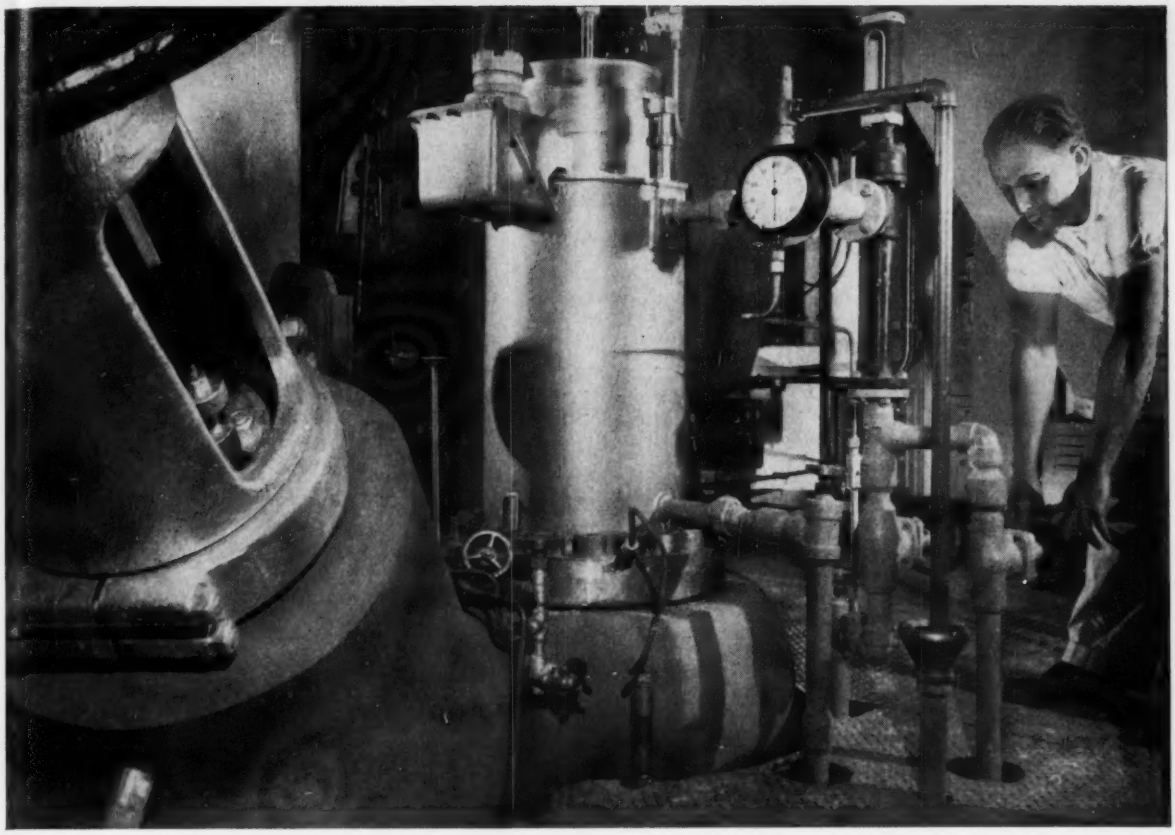
Centrifugal Pumps. *By Igor Karassik and the late Roy Carter. 496 pp, $15.75. F W Dodge Corp, 119 W 40th St, New York 18, N.Y.*

Designed especially for centrifugal-pump users, this practical guide avoids the highly theoretical aspects of pump design. Only theory necessary for proper pump application and operation is included.

Structural details of each centrifugal-pump type are covered at length. Special attention is given to common pump-component parts such as stuffing boxes, shafts and shaft sleeves, couplings and baseplates. Methods are recommended for the restoration of each component part to its initial condition after deterioration in service.

Centrifugal-pump performance, system head curves and service classifications give users an insight into selecting proper equipment for their application. Then recommendations on the preparation of centrifugal-pump inquiries assure them that they have been complete in transmitting their needs to the manufacturer.

Since drivers, controls and priming



This "canned" motor-pump...comprising a pressure-tight cell that houses stator and rotor (each in sealed "cans") plus impeller...circulates 4700 gpm of 605°F water at 1725 psi continuously in a closed loop system. Units can be built for pumping 5 to 17,000 gpm at pressures up to 2500 psi at 650°F; units for liquid metal, to 1000°F. A development of Atomic Power Div., Westinghouse Electric Corp.

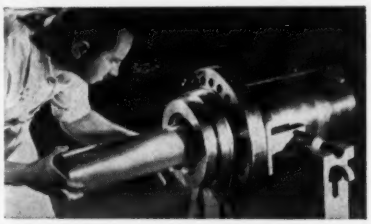
Pump made leak-proof...needed Inconel

For steam plants *today*...atomic plants *tomorrow*

THIS IS a "canned" motor-pump. It's completely sealed to circulate coolant in a closed system for as long as 20 years!

Without maintenance or leakage

Zero leakage is an essential for nuclear reactors, because their coolants absorb neutrons and become radioactive. Even the *smallest* leak could spell disaster.



Inconel liner seals stator from coolant. Another seals rotor. Liquid being pumped can flow between. No external shaft seals. No packing problem.

The canned pump may also prove a great advance for other high-temperature, high-pressure uses.

Basic to its success is Inconel* nickel-chromium alloy. Inconel helped the designers lick the induction-motor-operating problem caused by two metallic walls between stator and rotor.

Making the walls of Inconel—*thin* Inconel—gives them high electrical resistivity. Minimizes current loss. And there's no interference with magnetic fields.

In addition to being non-magnetic, Inconel nickel-chromium alloy provides high strength at 1000°F and above. It resists corrosive attack and stress-corrosion cracking, too.

The canned motor-pump is but one of many examples of why you'll find Huntington Alloy Products in tomorrow's nuclear-energy equipment...and in today's power plants.

Right now, consider *your own* particular problem. Perhaps a high nickel alloy will provide the exact physical, chemical and electrical properties you need. Let us help you find out. Write for our technical bulletin "Engineering Properties of Inconel".

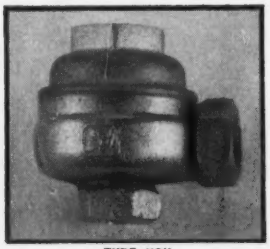
*Inco trademark

HUNTINGTON ALLOY PRODUCTS DIVISION
The International Nickel Company, Inc.
Huntington 17, West Virginia

INCONEL®

For more facts circle 334 on Reader Service card, p 103

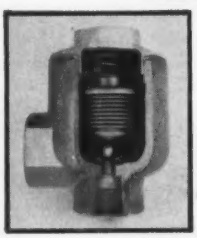
WITH STEAM TRAPS TOO—



TYPE "G"
Cast bronze bodies. 0-150 PSIG.
½" & ¾"

TYPE "L"
Cast steel bodies. 0-300 PSIG.
½" & ¾"

TYPE "P"
Semi-steel bodies.
0-250 PSIG.
½" through 2"
Also available as
Type "R" in cast steel.



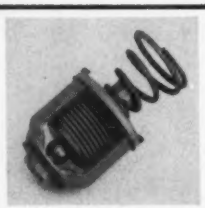
TYPE "S"
Cast bronze bodies.
0-250 PSIG.
½" through 1"

YOU DESIGNED THE B&J STEAM TRAP

Because you wanted the many advantages of thermostatic traps — high air and water capacities, simplicity, single orifice size over full pressure range, the ability of repairing and maintaining right on the line with a minimum of shutdown time and labor cost, plus dependable uniformity of operation obtained by calibration. Calibration permits use of a **one-piece interior** that makes the dream of simplified maintenance come true.

WHAT IS INSIDE THE B&J STEAM TRAP

A one-piece operating mechanism. A "Trap Within A Trap." All working parts of the B&J trap, bellows, plug **and seat** are locked in calibration inside a stainless steel cage which is completely independent of all tolerances in trap body and cover. **Not** a collection of parts to install, but a **single** piece to drop in while the trap is on the line.



CAGE UNIT
One-piece trap interior. Monel Bellows, Stainless Steel Plug & Seat. Calibrated for sensitivity.

BARNES & JONES, INC.
34 Crafts St. • Newtonville 60, Massachusetts

For more facts circle 335 on Reader Service card, p 103

Bookshelf

Begins on page 178

are a part of satisfactory pump operation, these topics are dealt with in depth. Installation, operation, maintenance and operating problems complete the users' picture.

This practical centrifugal-pump guide is drawn from the many articles published by the authors over the past 20 years. It brings together in one volume their extensive experience in centrifugal-pump application.

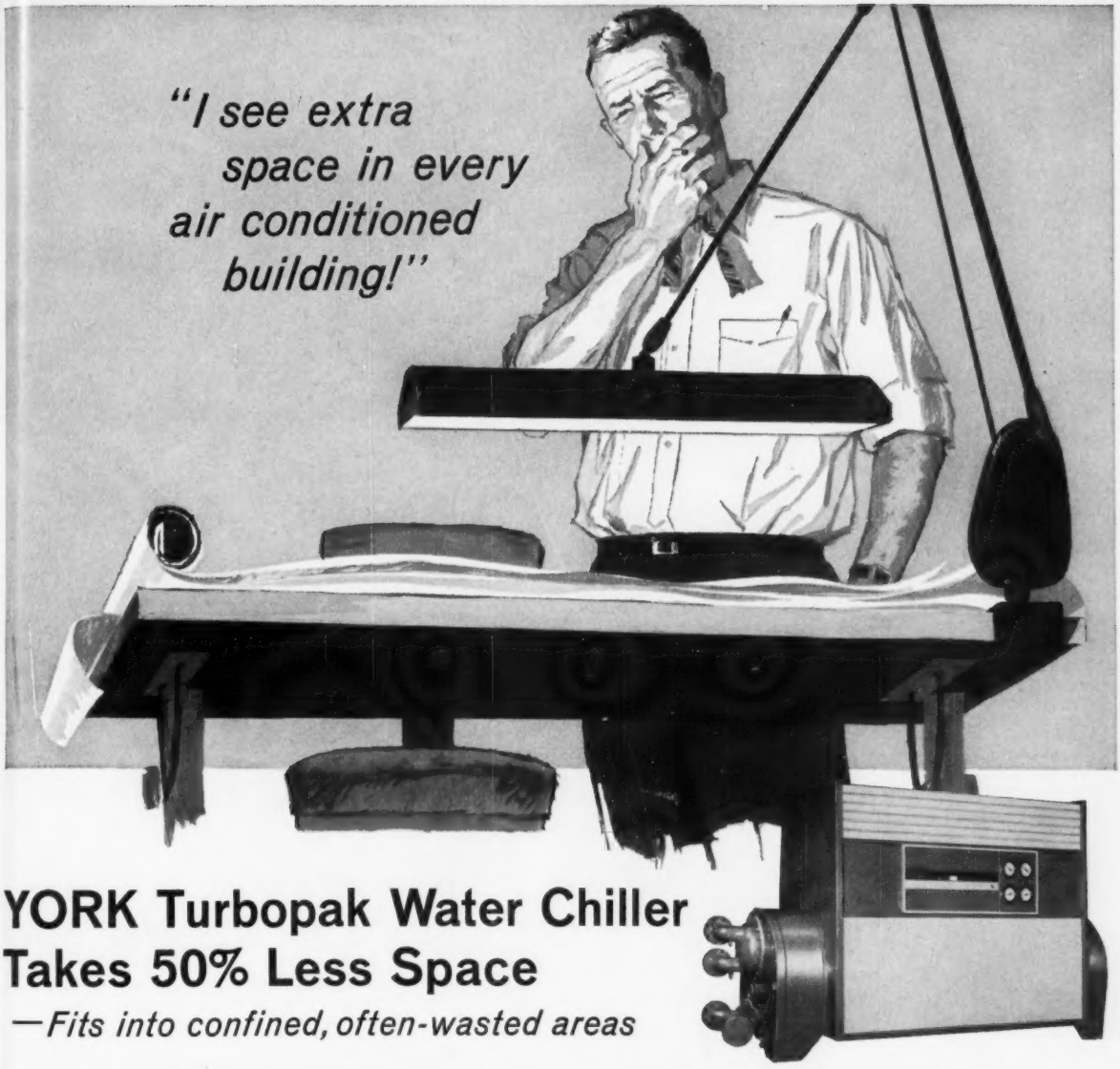
Introduction to Nuclear Power Costs. *By A Rochman, 50 pp, illust, tables, paper, $2.95. Simmons-Boardman Publishing Corp, 30 Church St, New York 7, N. Y.*

Monograph analyzes some factors making up the total cost of nuclear power, shows how variations in their value may affect the overall cost structure. Costs of the various factors related to nuclear fuels are first analyzed and then factors related to the capital structure, plant and equipment. Cost of services needed by the industry, costs which do not exist or are not of critical importance in conventional plants are also analyzed. Study winds up with the major cost factors, total fuel cost and capital cost of the nuclear reactor.

Aero-Thermodynamics and Flow in Turbomachines. *By M H Vavra, Professor, Dept of Aeronautics, U.S. Naval Postgraduate School. 609 pp, tables, illust, cloth, $14.50. John Wiley & Sons, Inc, 440 Fourth Ave, New York 16, N. Y.*

A theoretical approach to the subject based on the fundamental principles of fluid dynamics and thermodynamics, emphasizing basic physical processes rather than empirical methods connected with particular machines. Vector and tensor analysis establish fundamental flow relations.

Vectorial treatment frees the reader from the limitations of 2-dimensional thinking, makes it easier to visualize flow fields in space and establishes physical, geometrical and analytical relations simultaneously without the aid of particular coordinate systems. This method provides theoretical background very helpful in designing practical turbomachines.



YORK Turbopak Water Chiller Takes 50% Less Space

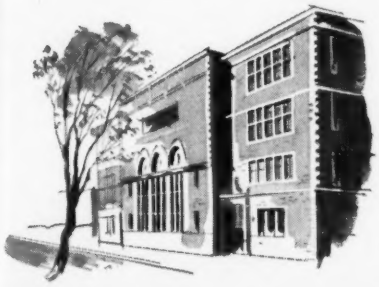
—Fits into confined, often-wasted areas

COMPACT, HERMETIC CENTRIFUGAL—A 130-ton Turbopak is only 14′ long, 5′ deep and 6¾′ high, nearly 50% smaller than previous designs. Exclusive Borg-Warner power transmission reduces compressor rotor size to gain space-saving compactness.

COMPLETELY FACTORY PACKAGED—To cut installation costs, the Turbopak is completely factory assembled, insulated, piped, wired, charged, tested. It's shipped and rigged as a single unit—no assembly or refrigeration piping on the job.

AUTOMATIC CAPACITY CONTROL—Pre-rotation vanes provide efficient capacity reduction to 5% of full load. This continuously variable control matches compressor capacity to air conditioning load, assuring maximum system performance.

ULTRA-QUIET OPERATION—Runs more quietly than water pumps that supply it. Quiet, vibration-free operation permits location anywhere. "Push-button" controlled from convenient electronic control center. 65 tons refrigeration and up.



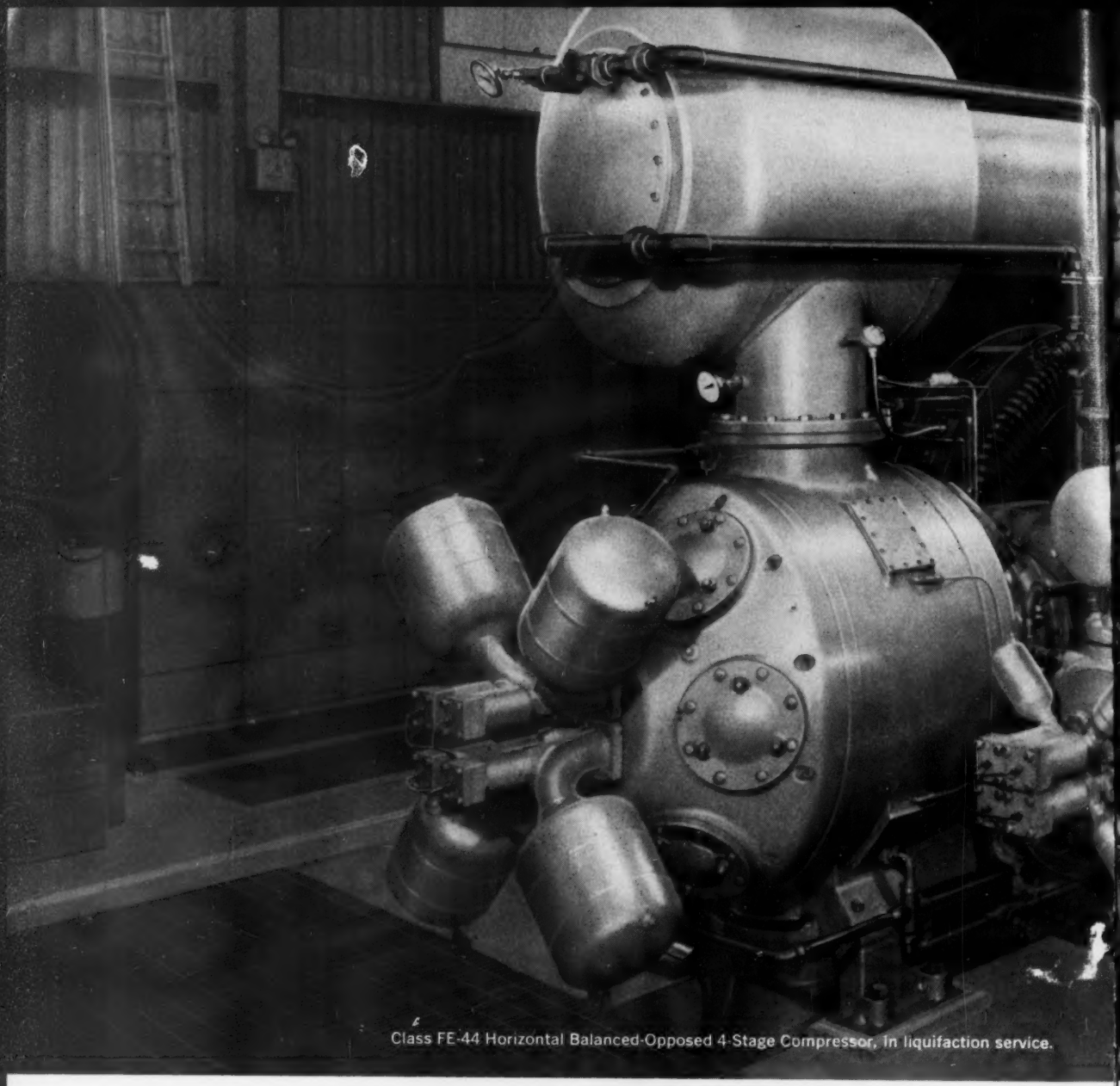
Another YORK Trail Blazer Concept Proved in Action at *Insurance Company of North America, Richmond, Indiana*—
A 125-hp York Hermetic Turbopak supplies chilled water to air condition this modernized office building. Cool, clean, dehumidified air greatly increases the comfort and efficiency of the employees.

YORK CORPORATION
Subsidiary of Borg-Warner Corp.
YORK, PENNSYLVANIA

2905 SOUTH GRANTLEY ROAD, YORK, PENNSYLVANIA

Air Conditioning, Heating, Refrigeration and Ice-Making Equipment • Products for Home, Commercial and Industrial Applications

For more facts circle 336 on Reader Service card, p 103



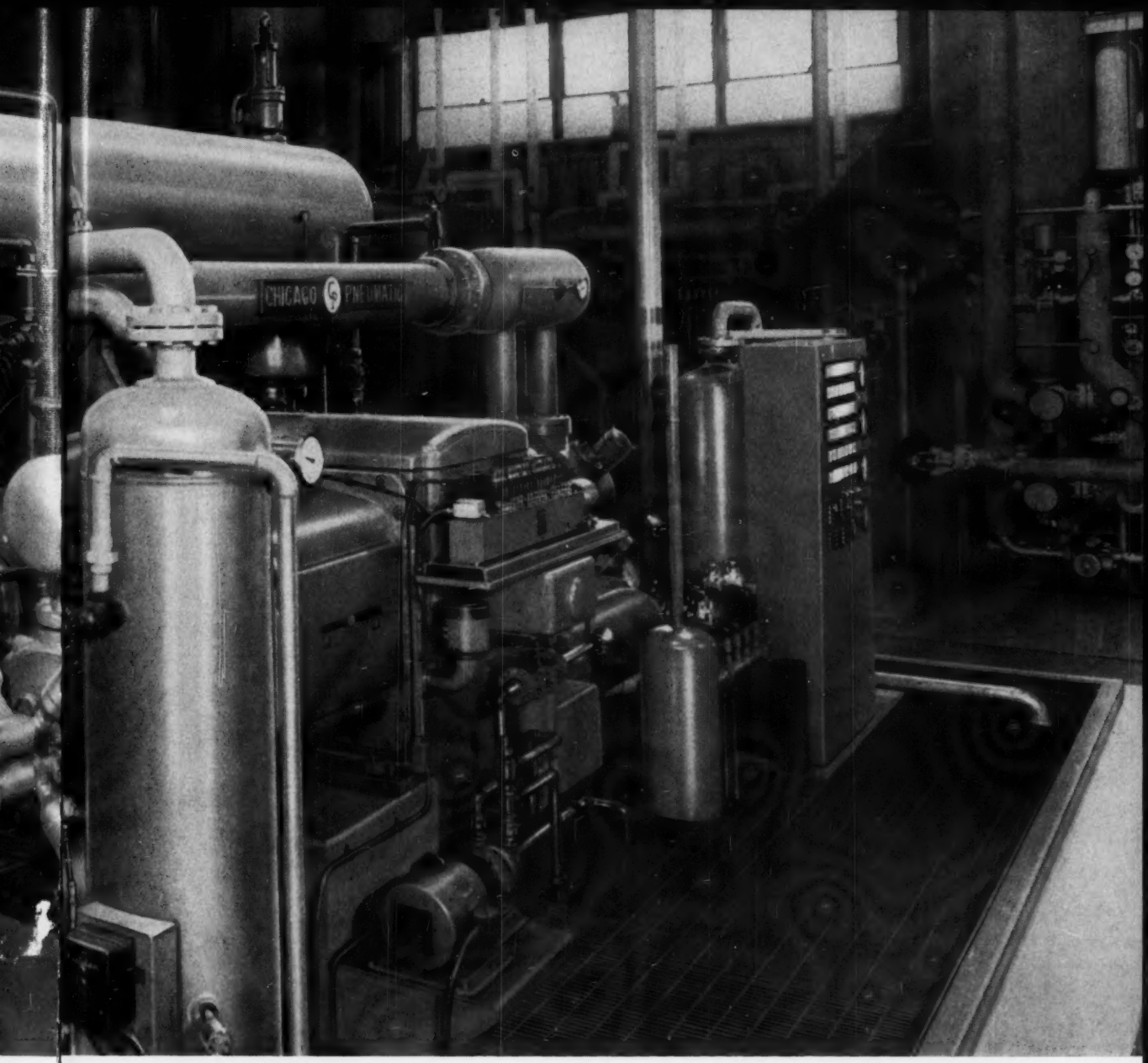
Class FE-44 Horizontal Balanced-Opposed 4-Stage Compressor, in liquifaction service.

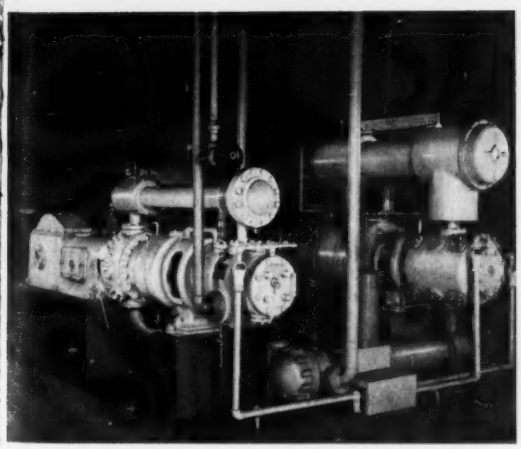
meet all High Pressure Demands with

CP MULTI-STAGE AIR and GAS COMPRESSORS

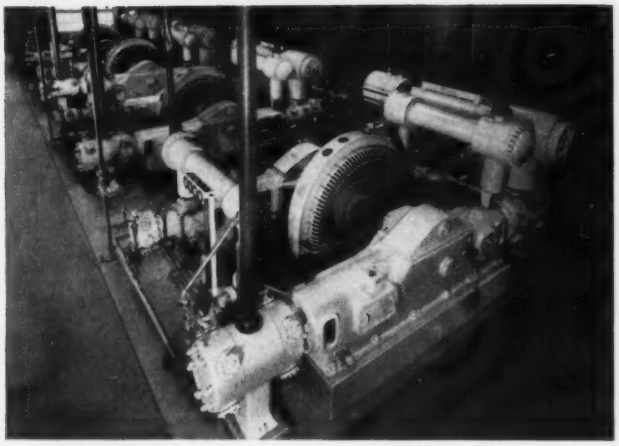
Gas liquifaction and other processes demand compressors that will produce high pressures and take continuous heavy duty in stride. CP Multi-Stage Compressors – Class FE's, H-CE's and O-CE's, for example – are meeting these exacting demands in a wide variety of applications. CP designs for such rigid requirements are available in horsepowers to 5,000, and pressures to 15,000 pounds. Write for detailed specifications.

Chicago Pneumatic 8 East 44th Street, New York 17, N. Y.





Class O-CE Horizontal Duplex, 4-Stage 250 hp Compressor in an oxygen plant.

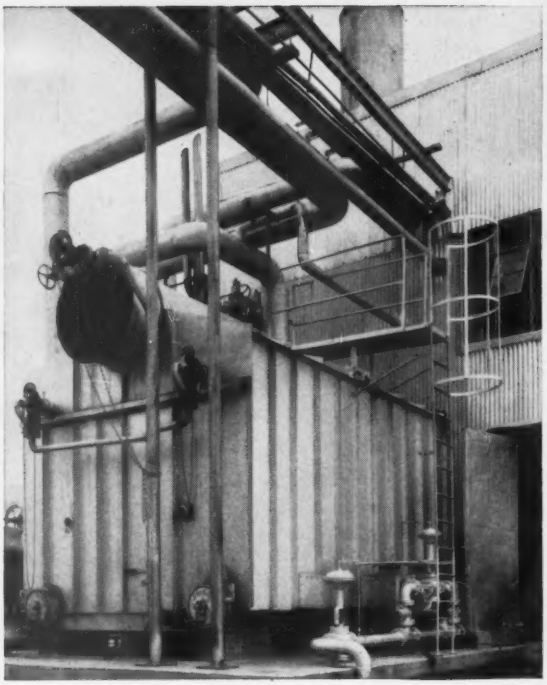


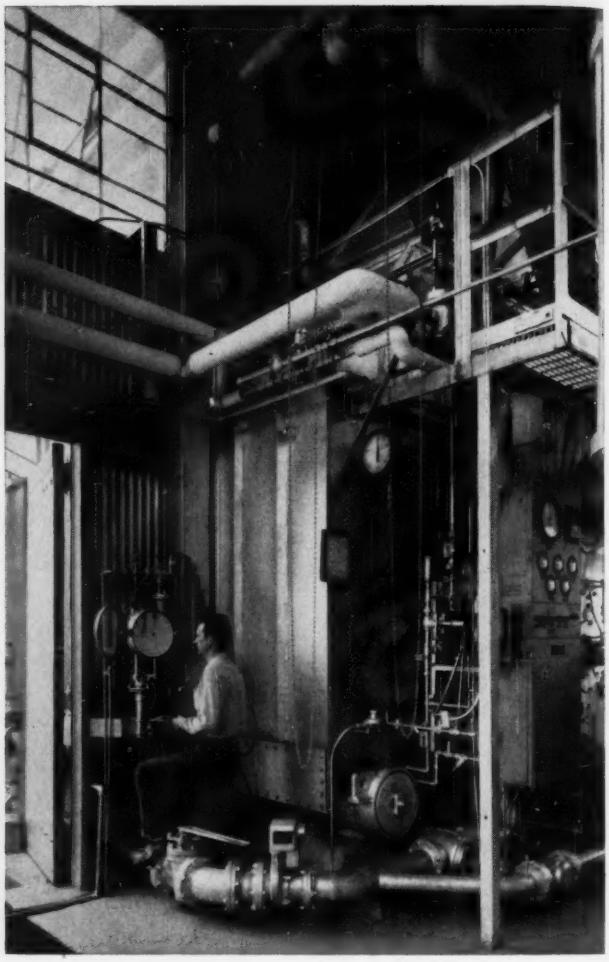
Class H-CE-5 synchronous motor-driven, 5-Stage Compressors in a chemical plant.

AIR AND GAS COMPRESSORS • VACUUM PUMPS • PNEUMATIC TOOLS • ELECTRIC TOOLS • DIESEL ENGINES • ROCK DRILLS • HYDRAULIC TOOLS

For more facts circle 337 on Reader Service card, p 103

Processing wallboard at Kaiser Gypsum





Union Packaged Boiler takes increased load in stride

A good part of the steam for processing gypsum wallboard at Kaiser Gypsum Company's Long Beach plant is supplied by the Union Type MH Packaged Boiler shown.

Semi-automatic fired with a normal operating pressure of 200 psi, this compact unit went on the job in 1956. Installed outdoors, it eliminated the need for further extension of the existing boiler house.

Although originally furnished to deliver steam for 2 out of 5 zones in a Coe Dryer, the MH was later hooked up to carry more of the load handled by an older boiler. Says the engineer-constructor, Kaiser Engineers: "The extra load demand on the Union Boiler was hardly noticeable from an operating standpoint."

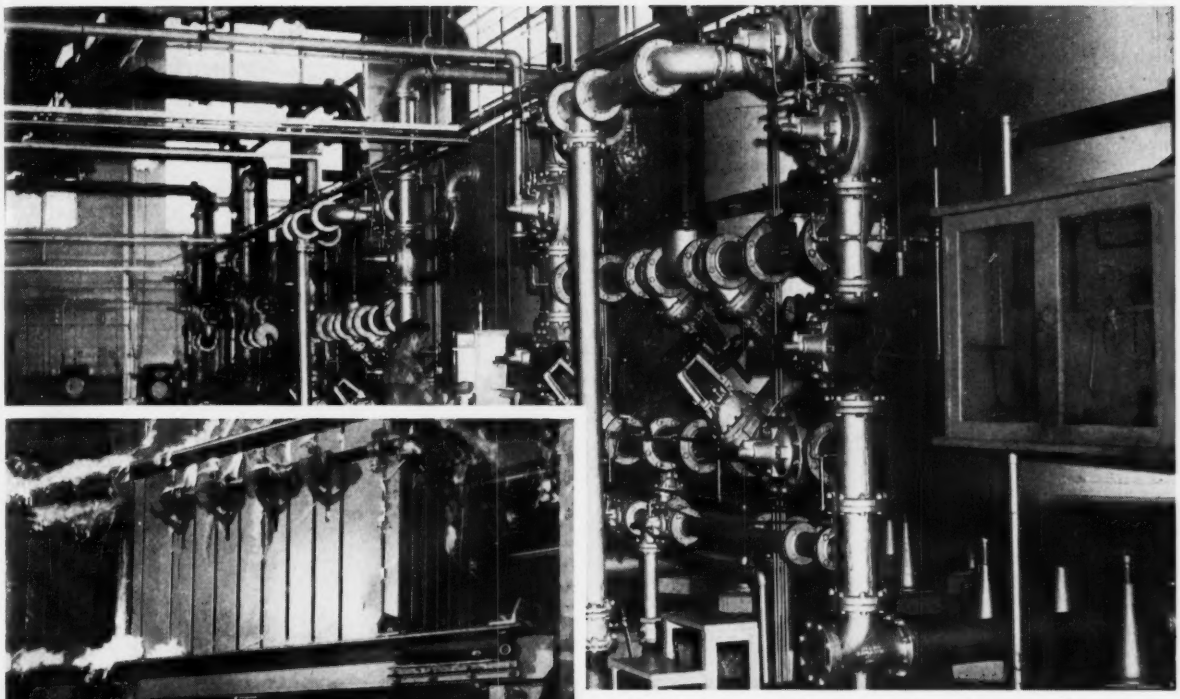
Throughout industry, similar reports verify reliable Union performance on stiff assignments. Job-proved designs, complete shop assembly, compactness, easy installation and above average efficiency combine to make Union MH Steam Generators the best dollar-for-dollar buy on the market.

Readily equipped to handle a great diversity of needs formerly requiring costly field erection and special engineering, Union Packaged Steam Generators are now operating at capacities over 100,000 lbs./hr.

UNION

UNION IRON WORKS
ERIE, PENNSYLVANIA
DIVISION OF RILEY STOKER CORP.

For more facts circle 338 on Reader Service card, p 103



ABOVE: AMBERLITE® 200 is used in two softeners in this group. Here the durable polymeric structure of this resin successfully resists the action of "aggressive water" which shortens useful life of conventional ion exchange resins.

LEFT: Baling of rayon staple fiber at Lowland, Tenn., plant of American Enka Corporation.

Enka rayon plant solves "Aggressive Water" problem with AMBERLITE 200

At the Lowland, Tenn., plant of American Enka Corporation, water for washing rayon staple fiber and yarn is breakpoint chlorinated to oxidize impurities. It enters softeners with 0.3 ppm residual chlorine. Trace metals present in the raw water act as oxidation catalysts and make the chlorine "aggressive" toward ion exchange resins. Useful life of conventional cation resins is shortened through decrosslinking which weakens the polymer structure, increases pressure drop, and promotes channeling.

When AMBERLITE 200 was installed in two of American Enka's ion exchange units, its revolutionary polymeric structure was the answer to "aggressive water". Wherever oxidation is a problem, AMBERLITE 200 gives longer resin life than conventional resins, and thus lowers operating cost. AMBERLITE 200 also has excellent resistance to bead cracking from physical stresses.

For more information on AMBERLITE 200 performance under conditions that degrade conventional resins, write for our technical bulletins. Also ask for a 16-page booklet that shows how many different industries use AMBERLITE ion exchange resins for specific applications—boiler-water softening and deionizing, chemical processing, and many others.

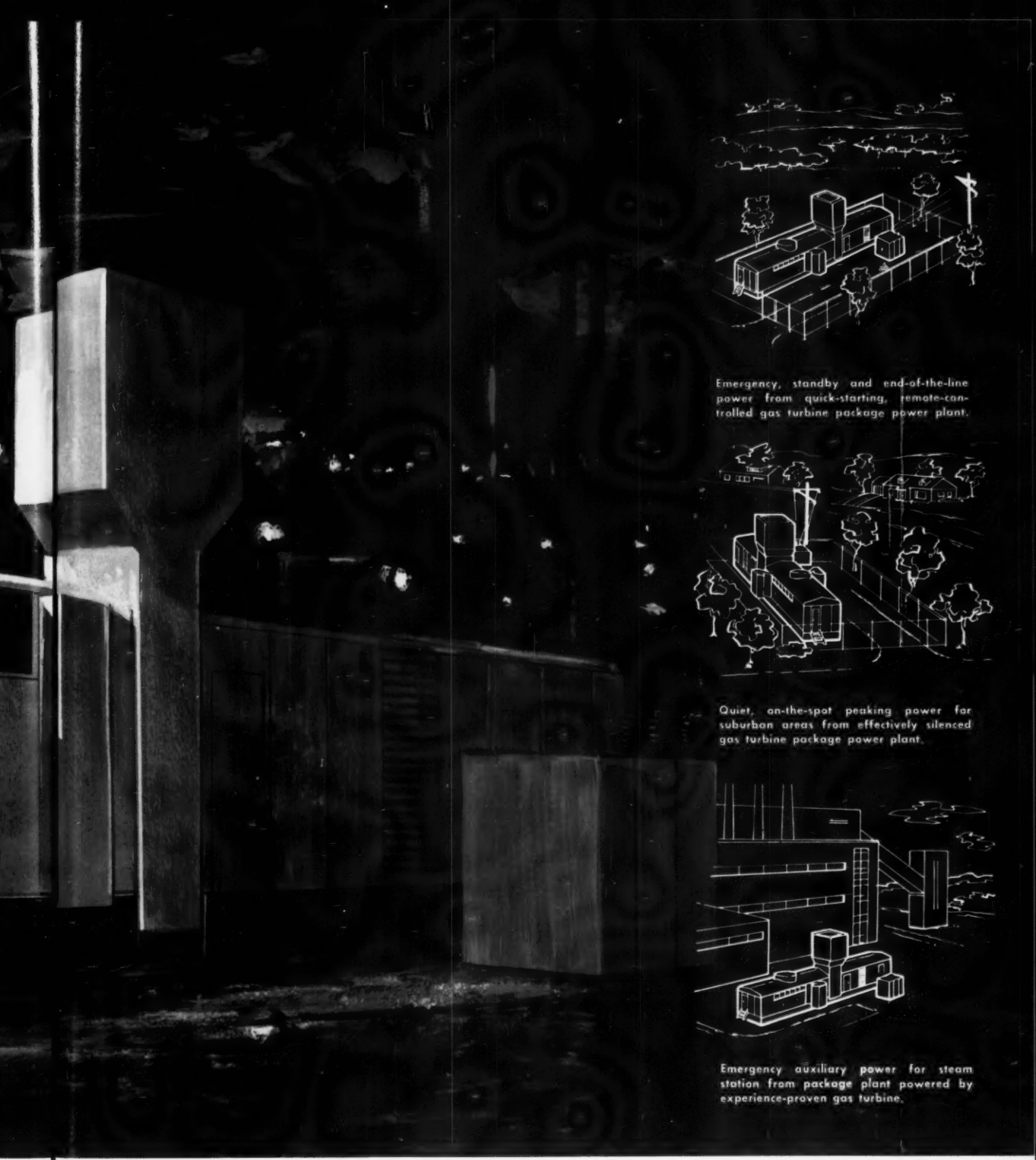
ROHM & HAAS

PHILADELPHIA 5, PA.

AMBERLITE 200

NEW... General Electric Package Power Plant Offers...

$85/kw multi-purpose power generation with proven gas turbine



Emergency, standby and end-of-the-line power from quick-starting, remote-controlled gas turbine package power plant.

Quiet, on-the-spot peaking power for suburban areas from effectively silenced gas turbine package power plant.

Emergency auxiliary power for steam station from package plant powered by experience-proven gas turbine.

Complete, self-contained, compact power plant — and it's available for operation on your system this year. The plant supplies dependable turbine power, 11,250 kilowatts*, for a variety of short-duration loads.

Package design offers significant manpower and maintenance economies, maximum site selection flexibility, and $85/kw low initial cost. G-E gas turbine reliability is backed by over five million hours of rugged operation — peaking and base-load utility service, continuous duty in process plant drives, start-stop service in locomotives, and base-load power for pipe-line pumping.

For more information on this new concept in power generation, contact your G-E Generation Sales Engineer or write for Bulletin GED-4217, General Electric Co., Section 247-44, Schenectady 5, N. Y.

* Peaking capacity at 80F, 1000-ft. altitude.

Progress Is Our Most Important Product

GENERAL ELECTRIC

NOW
THE FAMOUS "NO MAINTENANCE" PRESSURE REDUCING VALVE WITH NEW STEEL BODY

The Leslie GP-type pressure reducing valves are recognized as the simplest, most rugged, most maintenance-free ever made. Sold under Leslie's famous 3-year no-maintenance guarantee, they have so far been available with cast iron or cast bronze bodies only.

To satisfy the heavy demand for GP performance and construction features in 150, 300 and 600 lb. steel-body valves, here is the new Class GPS valve in carbon steel and alloy steels for steam, air, gas and other vapors.

The design still uses only two moving parts—a Spiroflex diaphragm and the main valve. These are virtually indestructible. There is nothing to wear out.

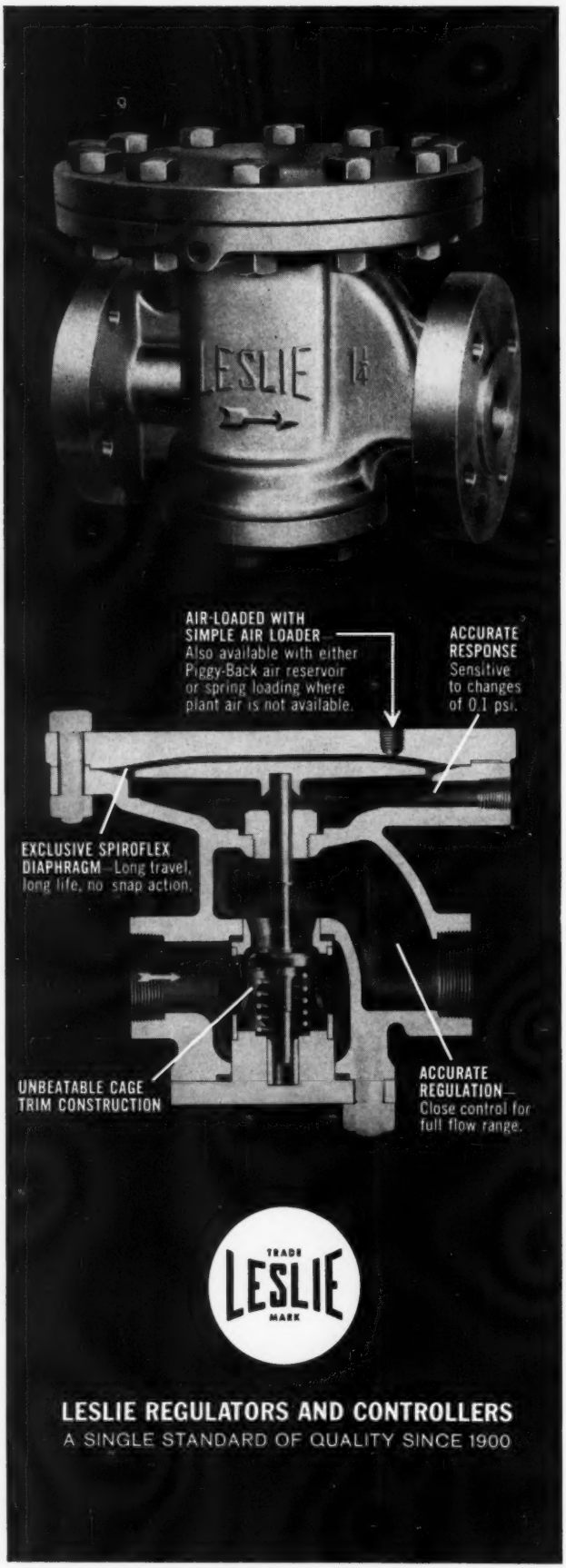
The low-stress diaphragm is the patented Leslie-Spiroflex®, which flexes like rubber but resists temperature as only a metal diaphragm can. Look at the cage trim construction—proved in Leslie-Lifetime control valves. Hardened stainless steel main valves seat on easily renewable, "permanent" type, stellited seat inserts. An unbeatable combination for long, trouble-free life.

The man to show you how much money this design will save you is your nearest Leslie Engineer. He is listed in the Yellow Pages under "Valves" or "Regulators." You will also want to send for our Product Data Sheet No. 611.

SPECIFICATIONS—Reducing Valve, GPS Classes

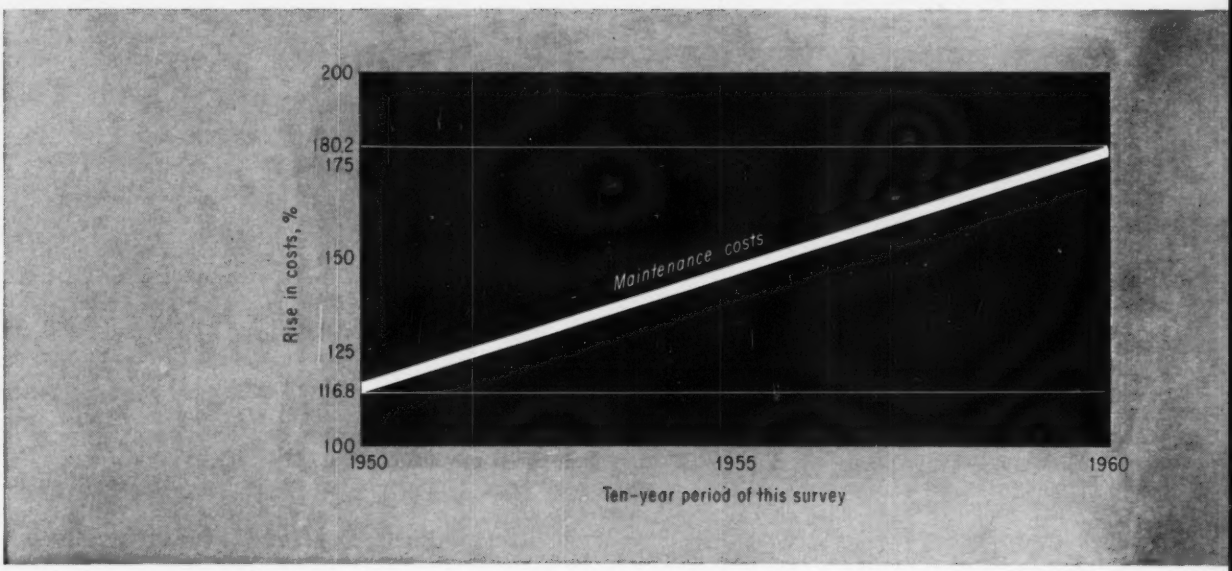
Sizes: ½" to 2" screwed or welding ends, or 150 lb., 300 lb. and 600 lb. flanges in carbon steel and alloy steels. Inquire about 2½ to 4" sizes soon to be available.
Diaphragm: Leslie-Spiroflex®, Stainless Steel.
Main Valve: Type 440C Stainless Steel, hardened.
Seat Ring: Stainless Steel, Stellited.
Stem Guides: Gun Metal Bronze (top and bottom guided).
Main Valve Spring: Inconel.
Inlet Pressure Range: 600 psi, 600°F.
Reduced Pressure Range: 0-300 psig.
Minimum Pressure Drop across Valve: ½ psi.

Leslie Co., 701 Grant Ave., Lyndhurst, New Jersey


LESLIE
AIR-LOADED WITH SIMPLE AIR LOADER—Also available with either Piggy-Back air reservoir or spring loading where plant air is not available.
ACCURATE RESPONSE Sensitive to changes of 0.1 psi.
EXCLUSIVE SPIROFLEX DIAPHRAGM—Long travel, long life, no snap action.
UNBEATABLE CAGE TRIM CONSTRUCTION
ACCURATE REGULATION—Close control for full flow range.
TRADE LESLIE MARK
LESLIE REGULATORS AND CONTROLLERS
A SINGLE STANDARD OF QUALITY SINCE 1900

STEVE ELONKA
Associate Editor in Charge

a Today's Development report



MAINTENANCE COSTS SHOT UP from 116.8 to a booming 180%+ in ten years. Which way now? (Year 1947 is used as the 100% base)

Can CM bring down your zooming costs?

Contract maintenance is on the upswing, varying from occasional peak-load servicing to an all-the-way deal. But there are two sides to the picture

By STEVE ELONKA
Associate Editor

As costs shoot up and profits per sales dollar shrink, industry is actively in the market for ways to cut plant-maintenance outlay. More and more, outsiders specializing in management, mechanical and electrical maintenance are called in to do the actual work of inspection, maintenance or both. Among the contracted-for services now available:

- Large firms contract for all the maintenance work of an entire plant, using their own men and equipment if necessary
- Manufacturers contract to service their own make of equipment on a yearly basis—including elevators, instruments, refrigeration and air conditioning, steam turbines, steam generators
- Job shops do all the mechanical and electrical repair work on a specific piece of equipment. These are usually local firms with highly specialized, well-equipped shops
- Insurance firms offer engineering, inspection and nondestructive-testing accident-prevention services to the general industrial public as well as their own policyholders

Let's go into the story of how others have turned to outside help for their maintenance work, see if *CM* may fit into your program. continued

Total, supplemental, periodic: the three degrees of *CM*

According to Catalytic Construction Co of Philadelphia, Pa., the largest firm in the U.S. and Canada offering maintenance on a contract basis, general maintenance contracts divide into three categories—essentially, three degrees of coverage. They range from an almost complete deal with most responsibility taken out of the owner's hand, to contract provision for a flying force to back you up only in an emergency, or when you've scheduled a turnaround, a complete overhaul, and want to save every possible downtime minute. These are the three degrees:

(1) Maintenance management. Under this program, basic responsibility for planning, coordinating, executing and supervising all work in the field is given to the contractor. You, as owner, need just a skeleton maintenance staff, large enough to coordinate requirements of your management and operating staffs with the contractor's representative. Contractor furnishes supervision, technical assistance, craft labor—practically a package maintenance deal.

(2) Permanent supplemental force. Maintenance engineering, planning and coordination is a joint effort by the owner's and contractor's organizations. For a portion of the normal plant maintenance, craft labor and its supervision is furnished by the owner. Contractor's supplemental force helps these people meet normal maintenance requirements. During turnarounds, shutdowns and other emergencies where maintenance loads peak, contractor's permanent supplemental personnel serve in a supervisory capacity and additional craft labor, supervision and technical assistance are provided as and when required.

(3) In the turnaround arrangement, owner provides staff and supervision for normal plant maintenance. When it's time for fastest possible overhaul of major equipment—turnaround, as the maintenance experts term it—contractor furnishes extra personnel, both supervisory and craft labor, to cope with the peak. Often you'll benefit by letting the contractor work out details of scheduling and coordinating the turnaround on a joint basis with your men. This setup, too, has the contractor standing ready to help out in shutdowns and other maintenance emergencies. When contractor completes the specific project, his work is done—he pulls out his men until next time you need him.

Under these arrangements, the owner is not committed to the union for any fixed craft ratio. In the three programs, skilled journeymen are hired under the terms of the contractor's agreement with the union. A small cadre of foremen and journeymen of the principal crafts —millwrights, electricians, pipefitters and laborers—required for the plant make up the hard core of the maintenance force. Extra journeymen for these crafts, foremen and journeymen from other crafts are hired and laid off as the load demands.

Some contractors even provide tools needed for peak requirements, or the entire project, for that matter. Contractor usually reviews safety procedures periodically with the client but uses owner's organization and facilities.

Technical help, too, can be contracted—usually only for as long as it's really essential: engineering assistance, procurement service, construction specialists, expediting, safety consultation, major and minor construction equipment, inspection services.

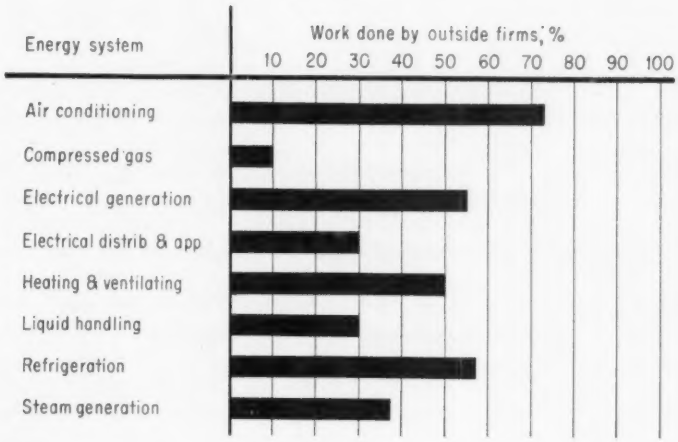
New ideas and improvements in methods of operation are a continual goal of leading contractors. For example, changes in tax structures, state laws and court decisions require constant study to determine if the traditional way of doing things is still best. This can be of tremendous help to the owner in stemming the floodtide of rising maintenance costs.

Cost of a full maintenance-management contract is usually based on the cost to the contractor of all personnel on the job—this means craftsmen, field-staff supervision and engineers—plus a negotiated percentage for overhead and profit. Percentage varies, of course, depending on the volume of work. Increments occur on a sliding scale; as the volume increases, fee decreases.

Hourly rates for contract labor—in construction trades, for example—are, as you might expect, higher than in-plant-employee wages for most skills. But—and here is where your good judgment comes in—total comparable man-hour costs of a contract may tot up to less when you include fringe benefits, plus the increases in basic rate for the permanent force caused by idle time, make-work, overtime, downtime on turnarounds and shutdowns, increased capital investment for facilities. Contractor's men may be more highly skilled, more productive.

In the petroleum industry, fringe benefits run around 23 to 25%. Contractor will normally pass some of these on to the client—social security and other wage taxes, workmen's compensation and other insurance, premium pay, employee facilities. But an analysis usually shows these passed-on costs as amounting to only about 10%.

Contract work—a big chunk of the maintenance pie



POWER's special survey shows a high percentage of maintenance work done by outside firms on a contract or job basis. Survey includes industrials, institutions, utilities and other stationary plants with energy systems. Air conditioning, for example, has 72% of installations repaired or maintained either by the original manufacturer, a service shop or contractor. Most large utilities do their own work, but often send components such as large turbine rotors to job shops. Survey is based on info from equipment users, manufacturers and machinery-insurance firms. Figures, of course, are approximate; results will vary widely between industries for obvious reasons.

Tidewater's Delaware City refinery, after five years' experience with contract maintenance, votes a firm "yes"

This firm has used *CM* since 1956. Here are highlights of their experience, based on a talk given at the 12th Plant Maintenance & Engineering Show in Chicago, Jan 25, 1961 by R B Beattie, superintendent of engineering, maintenance and construction for the Tidewater Oil Co.

The Delaware City, Del. refinery has 11 major units and a throughput of 140,000 barrels daily. Since 1956 the contract-maintenance work force has fluctuated between 150 and 924 men. Contractor has supplied field supervision for both normal and peak loads, engineering draftsmen, structural designers, process engineers, estimators, clerical assistance, engineering buyers and turnaround inspectors.

Refinery organization divides into three maintenance areas, each manned by a zone coordinator and his assistant, Tidewater employees. The zone coordinator is the absolute authority in his area. In addition to him, each zone includes a contractor superintendent and a planner. Actual mechanism of planning and scheduling is done by the contractor's employees, supervised by the Tidewater coordinator or his assistant.

Peak loads are responsible for the extreme manpower fluctuation—between 150-man low and 924-man high. Peak occurred when the 102,000-bpd catalytic cracker shut down and, two weeks later, the 88,000,000-cfd gas plant went offstream.

Contractor's manpower rose from a pre-shutdown level of 181 to 480 men at end of the first week, 900 men seven days later, then 924 men the next week. A week after the peak, manpower was down to 375 men, seven days later back to the normal average of 181 men. All units were on-line within four weeks. Important point: at no time was there a shortage of skilled manpower in the needed crafts. The contractor supplied additional field supervision from his other projects throughout the country during this period.

Contractor takes care of records on all equipment and for preventive-maintenance scheduling. *PM* is limited to oil and grease changes on motors, pumps and couplings; switch-house inspection; Tidewater's overhaul of the refinery-area compressors. But the refinery supervisor is essentially responsible for all work—or lack of same—done in his area.

Who supervises the work? At first, Tidewater insisted that a member of their maintenance group cosupervise all contractor's work. But after four years of working together the line between Tidewater and contractor supervision became faint. This was due to the single aim of both: do a good job. Besides, all of the area supers and planners had previous experience in refinery maintenance. Now, it's not uncommon to have a contractor supervisor in charge of an in-plant construction project, or bossing a complete shift on a large-unit turnaround. Conversely, a Tidewater supervisor may be in sole charge of a group of the contractor's time-card personnel. Either way, job gets done. continued

Extreme flexibility tailors work force to suit work load

Union relations are also in the contractor's lap. He has negotiated agreements with 14 building-trades unions on an international basis. A contractor's rep meets with them in Washington, D.C. once a month. Here the international officers review and resolve all problems from the preceding month. Agreement has a no-strike clause to guarantee uninterrupted maintenance work. This was clearly highlighted in the Philadelphia area last year: the construction boilermakers were out on strike for several months—but this strike had no effect on the maintenance boilermakers from the same union.

Contractor's project super meets weekly with shop stewards to discuss in-plant problems such as safety, working conditions, contemplated work load. Union policies and politics are never discussed, so most suggestions or complaints can be handled immediately—a morale and cooperation builder.

Tidewater has no direct dealings with the unions or their demands. Of course the contractor consults with Tidewater before spending money on equipment, buildings, changes or the like which may have been requested by the stewards. By the same token, Tidewater has no voice in future negotiations between the contractor and the building trades. But this is not necessarily a disadvantage—in any event a plant associated with a national union must conform to any industry-wide settlement.

No current training program for maintenance is under way at Tidewater, because the contractor supplies only skilled men and takes on all apprenticeship worries. In the beginning, Tidewater had the problem of training and adapting these building-trades men to refinery maintenance work. Now, during peak loads, the more-or-less stable work force takes over much line supervision. They take care, too, of on-the-job training and indoctrination of new men.

Company and the contractor together rate workers on ability—whether the man is competent, productive and skillful enough to fill his job. If the mechanic does not meet these qualifications, Tidewater does not consider it obligatory to continue his service; again, contractor works out the situation with the union.

Esprit de corps, morale, or whatever you want to call it, isn't too hard to pin down. Tidewater's work-force absenteeism runs below 3%, constructive suggestions to

Here, taken from Power's survey, the case 'for' . . .

Vice-president of large contract-maintenance firm: "*CM* shows great promise in two general areas: (1) any type of industry having high maintenance peaks. Examples are the basic steel industries, airplane manufacturers, oil refineries, tire and rubber firms, chemical industries, automobile manufacturers. In these areas *CM* can supply temporary manpower at a saving. (2) Any firm where maintenance management is below par."

General manager of large power-plant-equipment firm: "Preventive maintenance is handled in some plants on a yearly *CM* basis. The contractor can schedule plants in his area so his crew of specialists—say in steam-turbine work—moves from plant to plant according to a preventive-maintenance schedule. In this way the owner has the advantage of top-notch technicians who repair steam turbines the year around. Chances are the owner could not afford—would not need—the services of these highly skilled specialists often enough to keep men of their caliber on his payroll. Some top turbine and power-equipment manufacturers are thinking seriously of offering *CM* service on a yearly basis, repairing all makes of machinery. One reason: their many well-equipped shops already established in various parts of the country."

Refinery plant manager: "Because *CM* supervisors are on a competitive basis, and because maintenance management is their specialty, they are often more effective than the owner's people. They are usually trained in a service organization to give client service at lowest cost."

Chief engineer of a steel mill: "In plants grappling with costly featherbedding, *CM* can be the answer—at large savings. This is true regardless of type of industry, whether plant has stable manpower requirements or not."

Engineering consultant for construction firm: "If the contractor has agreements with an international union, large savings can be made by *CM*, especially if the plant has costly job-packing concessions such as foreman-to-worker ratios, fixed crews, arbitrary standby."

Works manager of a paper mill: "*CM* can be effective in plants having plant-wide maintenance work with upkeep, repair, replacement, alterations and minor improvement problems."

Management-consultant field man: "Labor force of *CM* contractor is on day-to-day basis but work in a given plant is usually on a 1-year term basis. If the contractor has a nation-wide agreement with all trade or craft unions needed for a given plant, uniform conditions can be established for that plant, making it an attractive owner-contractor relationship."

improve methods and procedures are constantly being volunteered, craft lines are lowered in time of emergency, mechanics and process people work together well and action is aimed at lowering costs and improving efficiency. This, the company feels, is esprit de corps of the finest kind.

On the subject of lowering costs and increasing efficiency, a work-sampling program over the past five months shows that 63% worker utilization is attained—factor calculated on a very conservative basis.

Tidewater has complete faith in the contractor. His longevity in this refinery is based on his performance—of which Tidewater is the sole judge. Each member of the contractor's work force has to perform in order to keep his job. Complacency is a rare quality—with a short lifespan.

So, with five years' contract maintenance under its belt, Tidewater is almost completely satisfied with the system. To sum up the major pros:

Greatest advantage of *CM* is its extreme flexibility, with work force tailored to fit work load. No "made work" is needed to keep the maintenance force busy. If the load drops off, work force does the same. If the work peaks in one or more specialties, contractor hires on in those particular fields. A refinery with a fixed maintenance force might have to make work, or go to the alternative of risking a force too small to handle turnarounds of large modern units most efficiently.

The contractor can terminate any portion of his force on as little as two hours' notice. Manpower required to meet the work load is decided by refinery supervisors. Suggestions and recommendations are presented to Tidewater by the contractor for acceptance or rejection. Of course, conditions have been worked out so the force doesn't fluctuate greatly from day to day—that would be bad for morale and uneconomical besides.

Another talking point for *CM:* the refinery doesn't have to depend on its own training program to produce skilled mechanics, with problems of qualification, ratings, testing. They needn't bother with union negotiations and personnel counseling. And contractor can supply almost unlimited skilled mechanics. For these reasons, the Tidewater people feel that contract maintenance is, for them, the best way to get most-efficient and economical work.

. . . and the case 'against' *CM*

Vice-president of management-consultant firm: "Cannot see how a contractor can save money for these reasons: (1) overhead of plant does not change (2) owner's employees are more familiar with the equipment than any outsider can possibly be (3) owner's crew has better supervision (4) present employees are more loyal (5) coordination is better between engineering and production functions (6) contractor does not use same personnel; he does not know his employees as well."

Engineering consultant: "Contractor's craftsmen on one job received $7200 yearly, while the same ratings employed by the owner earned $6000. This would indicate that the owner eventually paid more for the same work performed, or else did not know how to get the best out of his men."

Chief engineer of large institutional building: "We do not have enough highly specialized equipment to bring in highly technical men to do our maintenance work. Our own permanent staff is well-qualified to do our work."

Superintendent of large utility: "The tremendous complexity and diversity of utilities, machinery and equipment in some plants makes area familiarity with preventive maintenance mandatory right down to worker level. Don't see how outsiders fit into our plants."

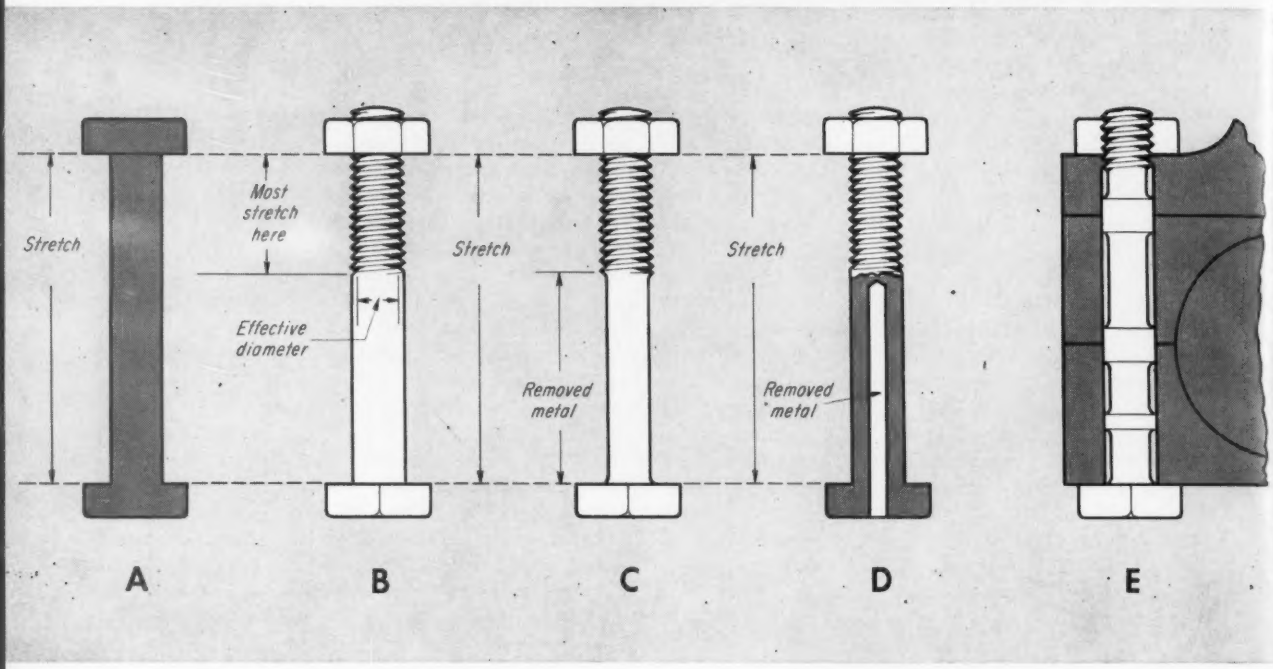
Superintendent of refinery: "The more *CM* personnel you have on a job, the more carefully you must inspect the quality of work. Most economical setup is to have your skilled maintenance force running maintenance. You may then augment these with *CM* men for peak loads, using your own men temporarily as lead men, pushers and foremen."

Chief engineer of chemical plant: "A plant must retain enough of its own supervisory personnel to supervise the contract, guarantee the feedback and analysis essential to improving equipment and process. One might assume that supervision by the contractor's men (generally union) is not of the caliber of supervision by plant men who are usually salaried."

Plant engineer of brewery: "Seems unfair to compare a poorly run maintenance organization to anything outside that's allegedly more efficient. Real trouble may be plant policies beyond the maintenance manager's control, poor equipment, or even a poor maintenance head."

Master mechanic of utility plant: "Maintenance of complicated equipment specifically designed for a given operation requires experience that is gained only by long service. Looks to me like *CM* does not provide employee interest factors to promote this long service."

Elongation of a bolt is an effective measure of stress



OPERATORS' NOTEBOOK **149**

By STEVE ELONKA, Associate Editor

Let's talk about bolt stretch and measurement

Tightening flange bolts uniformly and to the right tension is a vital chore. Experience shows that when you're working with high-temperature flanges, uneven bolt loading causes real trouble. Not only do gaskets deform, but flanges bend, bolts relax and finally the flanges start leaking. More loading may twist bolts or strip threads.

Last month, *Operator's Notebook 148* discussed prestressing bolts with hydraulic bolt stretchers instead of tightening them with wrenches. Now let's see how bolts act when they're pretensioned or torqued. We'll look at some typical and special-purpose bolts, see how to get the most life out of a bolt and how much it can be loaded to do most efficiently the job for which it was designed.

Elongation of the bolt is an effective measure of the stress it's carrying. Lab tests show that any steel is elastic, will stretch about 0.001 in. per in. of its length under a load of 30,000 psi *if* load is kept below the yield point. Soon as load is removed, steel returns to its original length. This happens regardless of the steel's hardness, whether it is stainless, carbon or alloy.

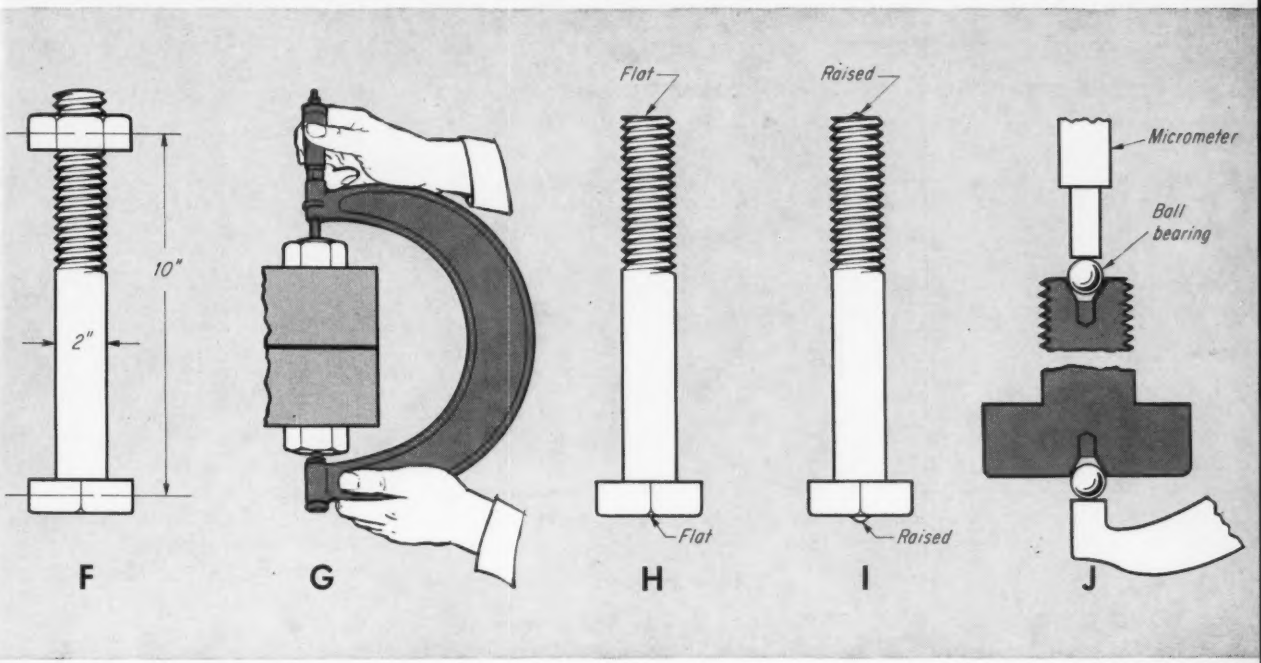
External forces acting upon a material produce tension, compression, bending, shearing or torsional stresses. And these stresses cause deformation. But as we mentioned before, if the stress isn't too great the material's elasticity returns it to its original shape soon as the stress is removed. If the metal doesn't take its original shape and dimensions, the *elastic limit* is exceeded. Then the bolt is *dead;* dangerous to use, it should be scrapped.

You can easily find the elastic limit or *modulus of elasticity* by dividing load in psi by elongation, in. per in. of unit length. Bolts made of steel average 30,000,000-psi modulus of elasticity, a figure to remember.

What bolt load should each stud carry? According to Edward Valves, Inc, bolting used with steel valves for pressures over 300 psi is usually alloy steel, having a yield strength of 105,000 psi. For best initial tightness in flanged joints, they recommend bolting loads under half this value, around 45,000 psi.

Ideal bolt would be tightened by upsetting the end like a rivet, sketch **A.** If it could be ideally loaded, entire bolt between the two heads would stretch evenly because the shank is minimum diameter over its entire length. But

it carries—but measurement must be accurate



most bolts are constructed like **B.** Their weakest part is the threaded section from the bottom of the nut to the end of the threaded shank. Effective diameter is measured from the thread roots as shown, so most stretch of the loaded bolt takes place in only a part of the length. Of course, parts above and below nut ends are not stressed uniformly, and threaded portion carries a varying stress. But rule of thumb for any bolt says total stress is divided equally along portion of bolt between nut centers.

Reducing shank is one way to increase the strength of a bolt, especially to withstand shock loads. Besides the remarkable increase in impact strength, modified bolts with reduced shank allow greater stretching or elongation if overtightened. That gives the nut less chance to loosen because of vibration. Resistance to fatigue failure also goes up and the bolt lasts longer.

Most of bolt **C**'s shank is turned down to the same diameter as the smallest diameter through its threads. Shank is reduced to a given optimum size, which depends on type, method of manufacture, etc. Interesting thing about this bolt: although it is modified to weigh less, it can absorb several times more impact energy than conventional bolt **B**, which may surprise you.

Another way to reduce shank area or theoretically make it equal to effective diameter through threaded section would be to drill metal from shank's center, bolt **D.** This would have same strengthening effect as removing metal from outside the shank. Bolt **E** is a special-purpose model, used for the connecting rod of large diesel engines, or for standard railroad-car carriages, large rock crushers, etc.

How to figure loadings? F is a 2-in.-dia bolt 10-in. long between nut centers. How much should this bolt be loaded? Answer is no mystery.

Let's assume we want stress of 45,000 psi. Divide 45,000 by the modulus of elasticity, 30,000,000. That gives us 0.0015 in. Since the bolt is 10-in. long between nut centers, multiply 0.0015 x 10 in. This means we'll stretch the bolt 0.015 in., which is to be added to the bolt length over ends. If all bolts in the flange are elongated or stretched exactly this amount, and taken up in sequence shown in last month's *Notebook,* flange and gasket should give maximum service for life of installation.

Method of measuring bolt stretch with a micrometer is shown in **G.** But if both ends of bolt are not parallel, readings will be off. You could grind or face off ends at right angles to the bolt shank by chucking in a lathe, **H.** Another way is to machine a small raised tit or bump on both ends as shown in **I.** Still another way: use a center drill and countersink both ends, **J.** Then you can set in ball bearings, measure with the micrometer.

Any measuring device that reads in thousandths of an in. will do. This might be an outside micrometer, vernier caliper or a dial indicator as used with tensioners.

If you're using a torque wrench, remember that friction between the threads and bottom nut will vary. So there will be a difference of elongation between bolts even though torque indicator reads the same for each. More-accurate method: predetermine the elongation, then, through sequence tightening, set all bolts to this value.

Next Notebook *will cover methods of torquing.*

With your instrument-maintenance department set up and personnel selected and trained, your next concern will be . . .

How to equip instrument-service crews

By V F TERRY, Product Service Specialist, and C A MATTOON, Field Engineer
General Electric Company Instrument Dept, West Lynn, Mass.

Effective instrument maintenance within your plant all hinges upon the efficient combination of men, methods and tools. In an earlier article, January 1961 POWER, pp 159-161, we discussed methods of organizing an instrument-maintenance department, personnel selection and training. Now, let's give our maintenance men tools to work with.

Tools for repair and servicing of instruments can be said to fall into four broad categories: hand tools, bench tools, special tools and the instruments used in calibrating and troubleshooting plant control systems.

Hand tools will vary with the type of instrumentation used in your plant and, after a period of time, the pet methods of individual instrument technicians. But to begin with, each instrument-service technician should have his own portable kit of ordinary hand tools—pliers, wrenches, screwdrivers and other small tools.

Bench tools which will be generally useful are jeweler's lathes, pin vises, small buffer grinders, a small drill press, arbor press and an ultrasonic cleaner for small metal parts.

Many instrument manufacturers design special tools to be used in testing, repairing and calibrating their lines of instruments. These usually are valuable as time-savers rather than basic necessities, but they're sometimes essential requirements of special servicing jobs.

Test instruments for your plant may be grouped into calibration and troubleshooting categories. In addition, they again divide into categories for portable and bench-mounted instruments.

In any plant, all precision-testing or -calibration equipment should be permanently located in an area where accurate work is possible. This technique of precisely controlled test conditions should be used wherever instruments may be brought to a single location.

Many industrial control instruments are permanently installed as part of process loops. The practical, although perhaps not most-accurate, method of checking these instruments is using portable test equipment to simulate the normal transducer signal. Many instrument manufacturers provide their field-service engineers with such portable test equipment. Most instrument-service groups, too, will find this an essential requirement.

Multipurpose circuit analyzers are indispensable tools for troubleshooting instruments and instrument systems in control loops. They're inexpensive and very useful for circuit analysis, but not of suitable accuracy or stability to be considered as "working standards." However, they are a very necessary tool to the service technician.

Instrument accuracy is a direct factor in operating cost of any modern plant. Under this condition, accurate calibration of instruments and controls becomes a major duty of your instrument department. In the performance of your calibration function you will become involved with measurement standards.

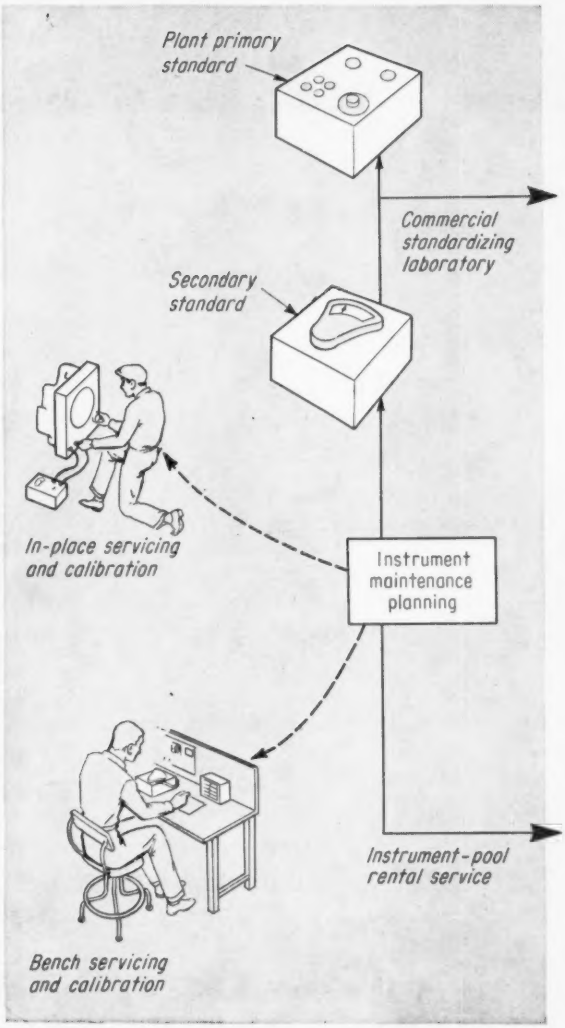
Test-equipment requirements vary greatly from one industry to another. However, in general you should plan to provide measurement standards for some or all of the following: frequency and time, alternating and direct current plus ac and dc voltage, resistance, capacitance, inductance, temperature, weights and measures, pressure and vacuum, flow, vibration.

These "secondary" or "working" standards must be periodically stacked up against a "primary" standard which, in turn, is compared with the ultimate standard at the National Bureau of Standards. Thus it becomes more or less essential for the instrument-service organization to establish a standards laboratory within its area of responsibility, or arrange for close liaison with a qualified lab. Most large instrument manufacturers have this kind of standards laboratory, and working standards may be referred to them for calibration checks at nominal fees.

Standards laboratory services may handle all or some of your work. This would depend upon the size and complexity of your operation. A well-organized department will set up as shown in the illustrations at right. Plan equipment use, purchase standards you can justify and make contact with other standards labs for additional calibration services.

You have now arranged for the majority of your instrument needs. There is one added area where outside help pays off—special-purpose instruments. For occasional or 1-shot tests you probably cannot justify purchase of instruments.

Special-purpose-instrument problem today is aptly solved by renting instruments from reputable instrument pools. Many equipment manufacturers maintain large selections of test instruments such as the group at far right. You may order equipment for an annual turbine-water-rate test, for example, knowing it will be fully calibrated and ready to go. Intelligent use of these serv-



EQUIPMENT PLANNING prepares instrument-maintenance group for varied types of in-plant service. Bench-mounted or portable instruments handle service or calibration needs. For special-duty standardization or test equipment, outside sources supply service

ices not only winnows out idle instruments but often permits you to justify testing you'd otherwise skip.

Instrument pools usually have on hand equipment in three categories: electric, mechanical and electronic.

Electric instruments account for some 65% of our company's rentals. These include indicating and recording instruments such as ammeters, voltmeters, wattmeters, frequency and power-factor meters.

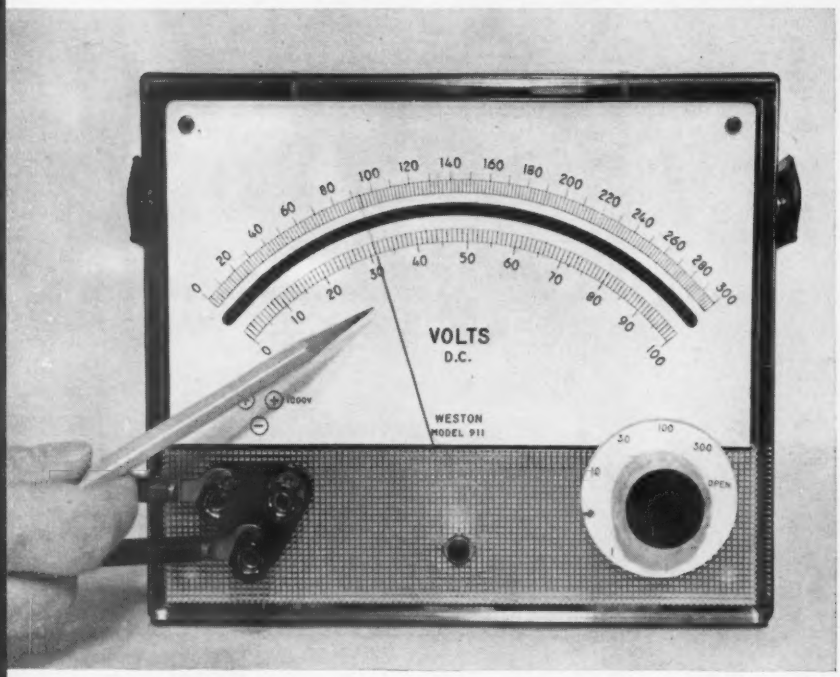
Mechanical instruments include all equipment used to measure mechanical quantities. This category contains process instruments which measure temperature, flow, pressure, displacement, etc.

Electronic instruments often find use in complicated and precise analysis of other instruments or process performance. Equipment rented may consist of oscilloscopes, vacuum-tube voltmeters, direct-writing oscillographs, amplifiers and many others.

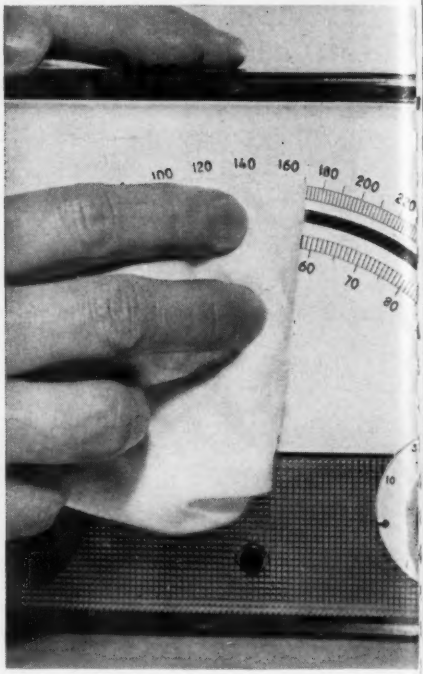
Since calibration and maintenance of rental equipment entails use of the very same standardization techniques you yourself need on occasion, contacting one organization probably will answer most of your needs in the areas of rental and calibration.

By following this step-by-step planning of your instrument service organization, you will arrive at an efficient group capable of handling most of your service problems. In addition, you will have a flexible base from which the instrument-service group can expand to serve your plant's future needs for accurate, dependable instrumentation.

One wipe with a dry cloth shows what static electricity

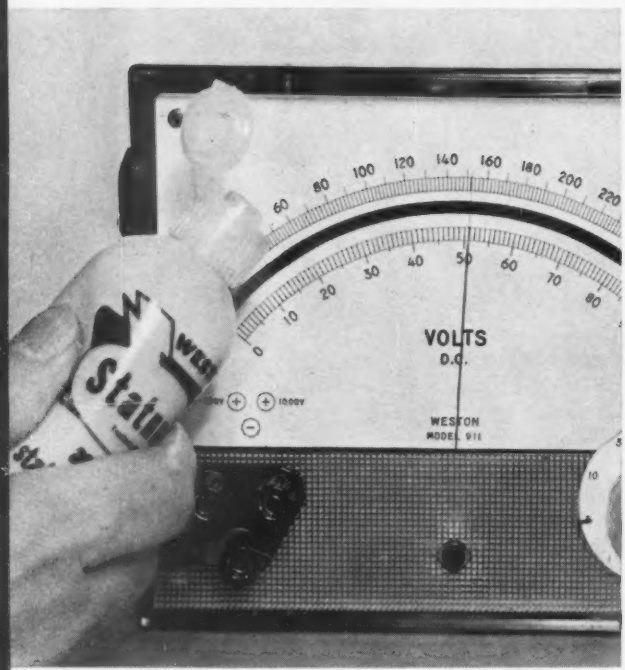


CORRECT READING appearing on portable voltmeter may be lost because of what is often considered careful maintenance. Needle rests at base value before static charge

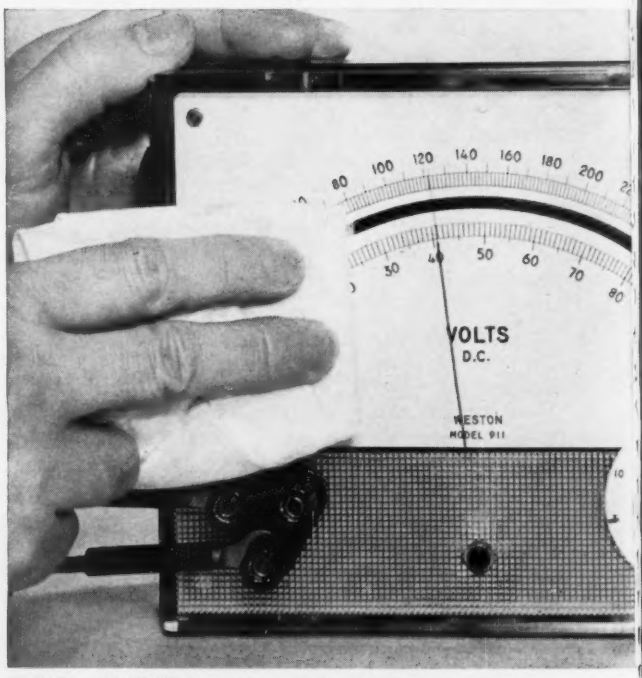


ONE WIPE with a clean, dry cloth will remove dust, leave static charge on face

But new coatings can prevent static buildup by providing

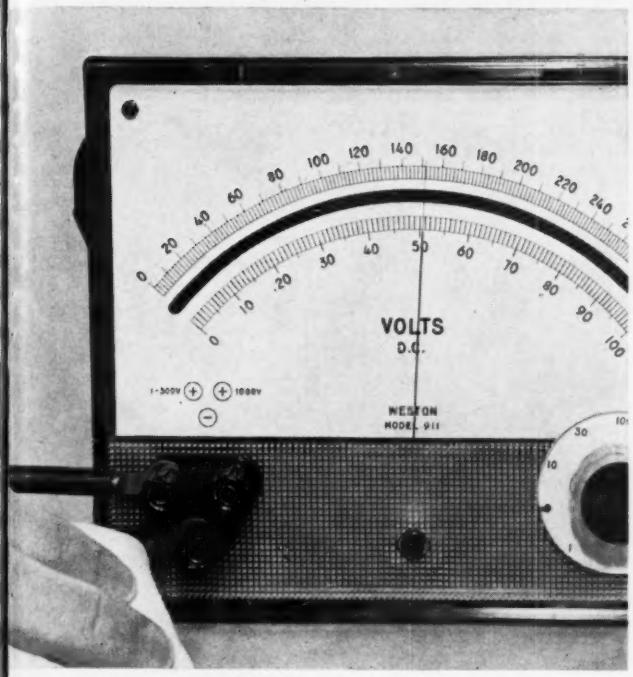


ANTISTATIC COATINGS are now applied by manufacturers, or easily applied by spray or pad to existing instruments in plant



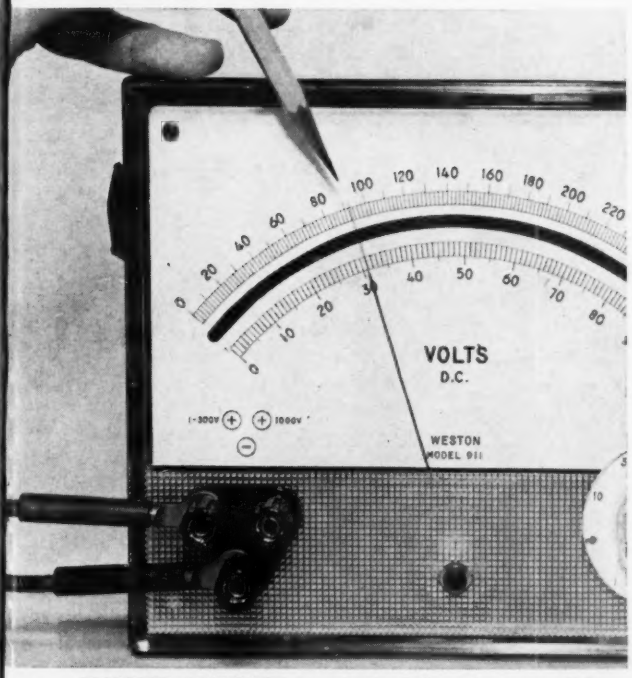
APPLIED COATINGS produce slight haze much like glass cleaners. As haze is wiped away needle will return to base point

does to instrument readings



INCORRECT READING results from needle deflection caused by accumulated static. Surface charge may be more than 100,000 v

effective discharge path



RESTORED ACCURACY is maintained through many polishings. Static will discharge properly in atmospheres with only 2% rh

Static charges cut instrument accuracy

Are you killing your instruments' accuracy with kindness? Many plant personnel do just that by installing meters and recorders in a good, dry, protected location and then polishing and cleaning religiously. Every action is designed to keep equipment maintenance down, but often the most conscientious housekeepers also demand extreme accuracy. Shooting for two goals, they may work at cross purposes.

To get a better idea of this problem, look at the photos, above left. Initial reading on the scale disappears as the instrument face is polished with a dry cloth. You have built up enough static electricity on the face to deflect the needle. And now you have a vicious circle going—the first charge attracts airborne dust and dirt which in turn necessitate more polishing. As a result a plant operator can polish himself right out of accurate readings.

Static voltages build up to extremely high values. When you walk across a plush carpet and touch that door knob you probably are discharging some 100,000 volts. Small wonder an instrument needle deflects!

What causes static buildup? The high insulating characteristics of materials used for instrument faces plus some special features of the plastics family. Glass-front units aren't immune to the problem, but it's more prevalent in equipment with plastic faces. Many plastics have molecular structures which store up a charge through the entire depth of the material. Even if the surface charge is drained off by humid conditions or other means, the interior charge keeps leaking to the surface. This continued replenishment of surface charge from within could mean a waiting period up to four years to leak off the charge.

Static prevention seems to be the only solution to this problem since redesign of instruments to compensate for the charge would be expensive if not impractical. Most instrument manufacturers have spent considerable time in an effort to come up with antistatic treatments for instrument faces. Success was limited because antistatic agents required relatively high atmospheric moisture to conduct static charges well. Since some plants record control-panel-area conditions as low as 2% relative humidity, charges still built up.

New static-treatment fluid, demonstrated below left, is the result of several years' development by Weston Instruments Div of Daystrom, Inc. Aimed at improving performance of equipment they produce, it remains effective down to 2% rh. Base of fluid: a long-chain molecule highly attractive to plastics on one end. At the other end of the chain, an ion link provides an excellent conductor independent of moisture.

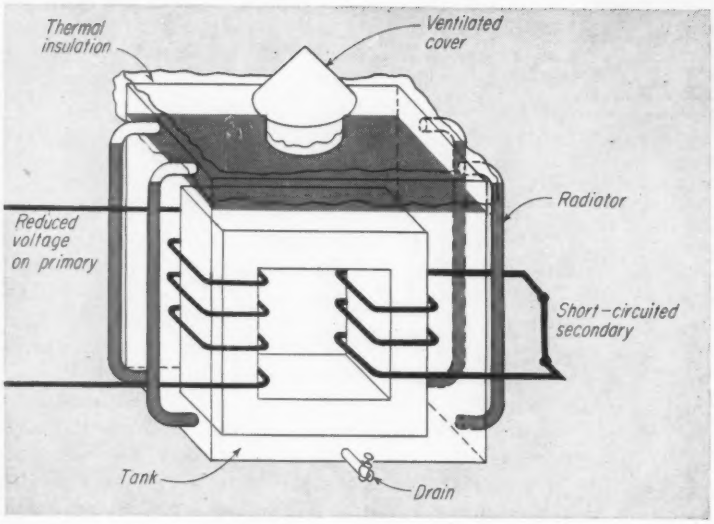
A quick and easy application of the fluid to both sides of an instrument face seems to keep you out of trouble for long periods of time. If the coating wears thin on the outside face, a reapplication wipes away your static error.

Plant Electrical Fact File

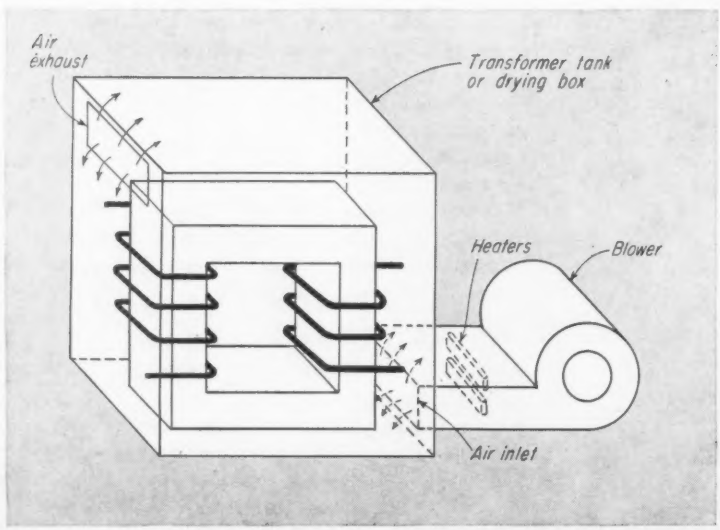
NO. 58: DRYING TRANSFORMERS

4 practical methods for

By NORMAN PEACH, Associate Editor



1 INTERNAL HEATING is produced by short-circuiting the secondary and applying enough reduced voltage to primary to circulate desired percentage of normal secondary current (often about 75%). Oil is left in tank, but circulation is stopped by radiator valves or lowering level below upper radiator connections. Ventilation is provided through cover, and cover is blanketed to keep up its temperature and prevent condensation. Drying temperature is too high for filter-press operation, so before starting drying run, drain free water from tank and remove water from suspension in oil with a filter press. Condition of oil is fairly good indication of progress; test at regular intervals

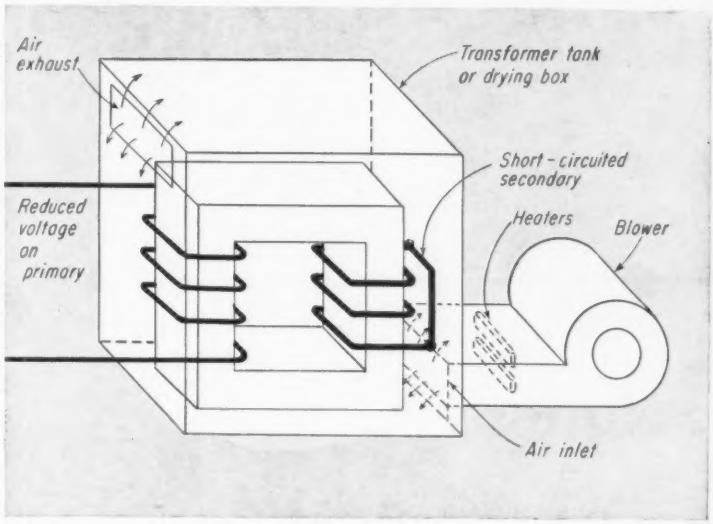


2 EXTERNAL HEATING can be done with the transformer in its own tank drained of oil, or removed from tank and placed in drying box. A blower or fan forces warm air through the tank or box, with an inlet at the bottom and an outlet near top on other side. Since it's essential to force as much air as possible through ducts in winding, you may have to use baffles between core, coils and enclosure walls. Source of heat may be electric, steam or burner, but air must be kept clean. Burner is used in connection with heat exchanger; take care that scale from electric or steam heaters doesn't blow into transformer. Air temperature must be measured at inlet to avoid any sudden overheating

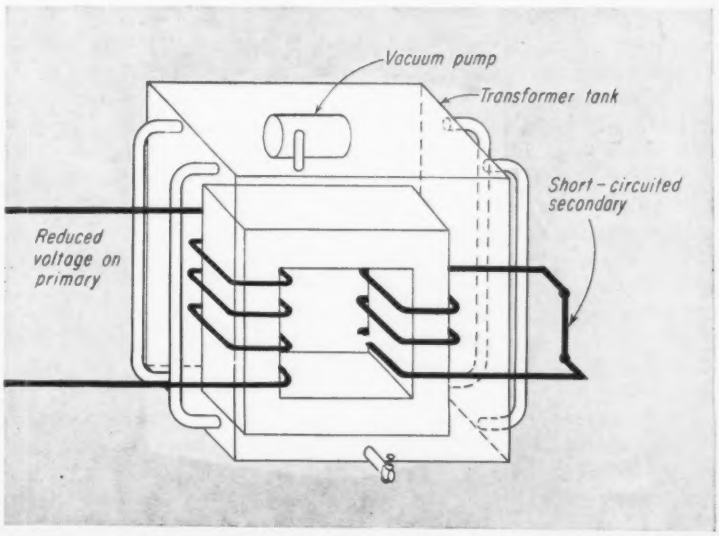
drying transformers

Sometimes transformers get wet as a result of floods or unusual absorption and condensation of moisture. Drying methods outlined must be modified to meet conditions of transformer types. There's no definite time to dry—some transformers may take several weeks. Progress is determined by insulation-resistance or power-factor tests. Temperature of winding during test (especially methods *1* and *3*) is usually best measured by ohmic changes using dc. Drying with oil in tank, keep temperature between 75 and 85 C. Drying outside tank, don't let temperature get above 100 C. Thermocouples or spirit thermometers (never mercury) may be placed inside top of windings.

3 COMBINED HEATING, internal as well as external, is faster and heats transformer more uniformly, but requires more careful supervision to avoid overheating insulation. External heat is provided as in method *2*; internal heating as in method *1*, except that circulated current is less. This method is used more often with dry transformers than with liquid-immersed types. Great care must be taken when drying without oil. Because temperature rises rapidly at first, read thermometers at ½-hr intervals. Keep one thermometer where it can be read without changing its position. Shift others about until you find hottest spots. Check temperature by increased resistance if possible

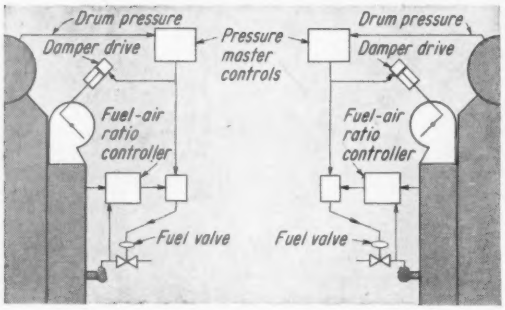


4 VACUUM AND HEATING combination is fastest and produces a more thorough and even drying of core and coil elements. Use transformer tank or a specially designed tank. You must know amount of vacuum your tank will withstand; if it's not marked on nameplate, obtain from manufacturer. Apply vacuum through fitting on tank top, or top filter-press connection. Heat transformer evenly by methods *1*, *2*, or *3*, (remove oil quickly following *1*); then apply vacuum. Vacuum reduces boiling point of water, thereby increasing rate of moisture removal. Precaution: if insulation is quite wet, vacuum at too-high temperature may cause rapid formation of steam which can rupture insulation



These **plant problems** could well be yours...

Problem . . . What makes our boiler controls hunt?



We have two 30,000-lb-per-hr watertube boilers operating at 225 psig supplying saturated steam for process and plant heat. Units include separate pneumatic combustion controls, single-element thermal feedwater regulators and separate pneumatic pressure masters. Each master positions its fuel and air in parallel. Combustion controller resets air-fuel ratio. After two years' satisfactory operation we replaced some worn parts and our own men adjusted controls. We were careful to get duplicate settings of all controls and set both masters for a 5-lb range in pressure.

Now both boilers hunt. They seem to fight for load. We must run one unit on hand to quiet hunting. We have checked controls and find nothing wrong. Can someone pinpoint hunting?—*JAS, February* POWER

Solutions...

Stagger boiler pressure ranges

According to what *JAS* states, he is trying to make both boilers operate at exactly the same load and conditions. This is feasible theoretically, but not practically. Just like human beings, boilers are subject to change. Slight variations in water level, oil temperature, oil pressure and water density at a prescribed moment greatly affect the output capacity of a unit. Just like humans, if one has a little greater capacity than the other, when one has a bad day and the other has a good day both accomplish approximately the same for that day.

When two boilers are operated in parallel, one boiler should be set to operate just a little ahead of the other. This is called "leading" control operation.

From the little *JAS* says, I gather these are completely automatic units, igniting and cutting out automatically. I also gather that the 5-lb range that the boilers operate in is exactly the same, say 220 to 225 psi. The latter appears to be the basis of his trouble.

In general practice, most engineers operating these boilers would set the master of one boiler to operate at a pressure between 218 and 223 psi, the other boiler between 215 and 220 psi, with the first boiler set to cut out at 225 psi and the second at 223 psi. In this way the boiler operating at the lower pressure would fire fairly constantly and the boiler operating at the higher pressure would handle the swing in the load. *JAS* is doing just this at present by operating one boiler on hand and the other on automatic. The one on hand operates at a constant load and the one on automatic handles the swing in the load.—J L DOWNING, *Brooklyn, N.Y.*

Operate your units in parallel

JAS does not advise whether his two boilers are of the automatic packaged type. If they are not, there is not much point in operating the two boilers from individual master pressure controllers. Consequently, our first recommendation would be to operate both units in parallel from one master.

The boilers are apparently swapping load. This fighting to control pressure could be caused by both boilers trying

...Here's how Power readers would tackle them

LAWSON STEWART, Associate Editor

to control exactly the same pressure. If the set point of one of the pressure controllers is adjusted to control a slightly different steam pressure, the hunting may be eliminated. A difference of five lb should be sufficient.

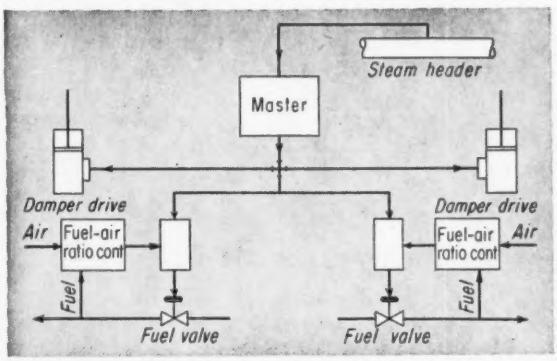
We would normally think that a range of only five lb with a boiler operating at 225 psig would be too "fast" and would be the cause of hunting. However, if the hunting stops when one boiler is placed on hand, this would not seem to be the difficulty.

C E HATTON, *Haverton, Pa.*

Bring drum-pressure lines to one master

I am curious about *JAS*'s two years of "satisfactory" service since the problem presented is fundamentally one concerning application of control instruments. From the information supplied, I assume the throttling range was less than 2%. With such a small range, any slight deviation or overshoot on one boiler (perhaps caused by a sluggish feedwater regulator or by load change) would immediately cause one boiler master to modulate to maintain pressure; the other master then attempts to rectify the overcorrection caused by the narrow throttling band, and cycling begins to build up.

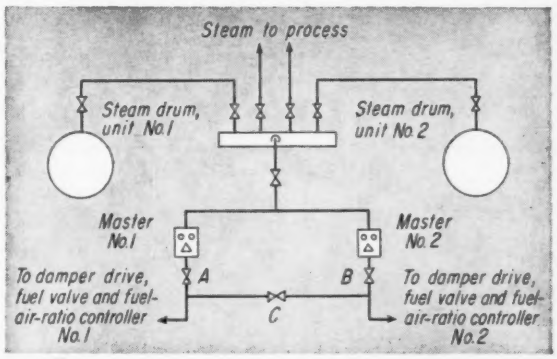
I suggest *JAS* manifold the drum-pressure sensing lines to a single master which would supply both fuel-air-ratio controllers. Hunting will disappear if proportional band is small enough to decrease offset, but sufficiently large to avoid instability.—P HAHN, *Norristown, Pa.*



Use one master with header pressure

The two boilers hunt and fight for load because there are two masters fighting for control during load changes, water-level fluctuations, etc. The two years of satisfactory operation were probably due to the fact that one master or control system was a little sluggish and followed the more sensitive one. Now that controls have been overhauled and are performing in an equal manner, each master, as the name implies, will attempt to gain full control, thereby setting up a cycle or hunt between the two boilers.

My solution to this problem is shown in the sketch below, left. Eliminate a master. Tie the controls together to one master with individual boiler fuel-air-ratio control and a pressure signal from the main steam header rather than the steam drum. This will result in a constant header pressure. Both boilers will respond to load changes at the same time.—L C SMITH, *Green Bay, Wis.*



Revamp boiler control lines

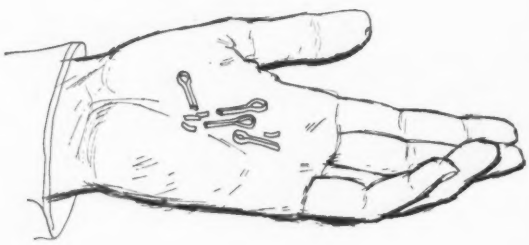
Swapping load back and forth between two boilers with the controls hooked up as per *JAS*'s sketch is a lot more common than two boilers with this hookup sharing the load equally. I have found that a minor retubing of the two master pressure controllers as shown above eliminates the problem.

First of all, use a common source of pressure at the boiler-room header rather than the steam drums. Then with the installation of valves *A*, *B* and *C* and the bypass, only one master is used to control both units. As I've set up my sketch, No. 2 master controls both units. But with the proper manipulation of valves, No. 1 master can be made to do the job. Or either master can be made to control either boiler alone.

L A WATSON, *Atlanta, Ga.*

Want some help on plant problems? Send us any of your design or operating headaches for Power reader comment

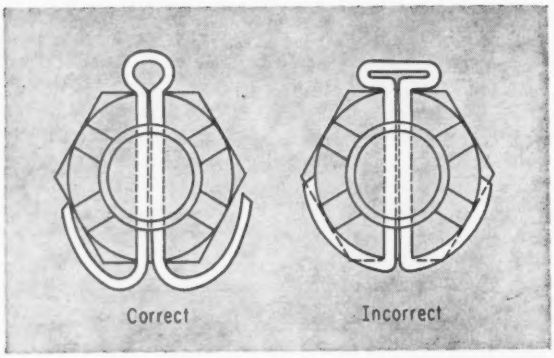
Problem . . . Why do cotter pins break?



We have an engine-driven air compressor which seems to be in trouble. Unit supplies 210 cfm of 100-psig air and is driven by a 51-bhp 6-cylinder 1200-rpm internal-combustion engine. Basically, operation has been completely satisfactory.

Recently the unit completed 1000-hr operation and was opened up for inspection. We found pieces of cotter pins mixed with the sludge in the crankcase. Examination showed they came from the connecting-rod bearing caps. There was no pattern of breakage and luckily the castellated nuts remained tight. Remaining cotter pins were removed and found in good condition. Problem: what caused this failure and can we guard against it?—*TDO, February* POWER

Solutions . . .



Suspect overstress or reuse

Cotter pins may fail in service without the nuts slackening in at least two ways. A cotter is severely stressed when it is bent back against the edge of the slot in the castle nut. If it is bent too sharply or hammered back against the nut, it may be both nicked and overstressed, leading to failure. Flattening the eye of the pin has the same result. Correct and incorrect methods of spreading are shown in my sketches.

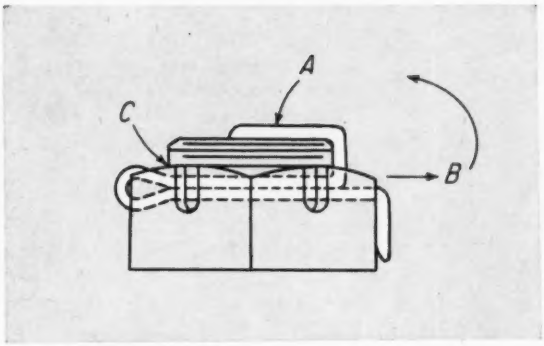
The other cause of failure is reuse of pins. Even when properly spread, a pin is severely stressed and work-hardened at the point where it leaves the groove. Closing up and opening a second time can make it so brittle at this point that it fails easily under vibration. A cotter pin, once spread, should never be reused.

P D HOBSON, *Concord, Calif.*

Sounds like improper pin material

Cotter-pin failures of this type sound like incorrect installation of pins or improper material for the pins. Installation methods are usually tagged with the blame. But I would like to point out that cotter-pin material can be a factor—and one that's usually overlooked in analyzing failures. Pin material in every case should be selected to prevent in-service annealing at engine temperatures. In addition, it should be pre-annealed to cut stresses.

W D ARCHBOLD, *Toronto, Ont.*



Follow this installation procedure

A properly installed cotter pin will have a vague resemblance to the sketch above. The method of installation is as follows: First, be sure the pin fits the hole snugly and is of the proper length. Secondly, grasp tine *A* firmly with a pair of diagonal cutters and pull in direction *B* to draw the eye of the pin into the hole as far as it will go. Then "swing" the tine up over the top of the stud (losing none of the tension gained by pulling in the *B* direction) and lay it flat on top of the stud. This tine should follow the contour of the stud as shown and the end should be cut off to leave no tool marks. The other tine should be bent downward against the nut in much the same manner. A properly installed cotter pin will have *no slack whatever.*

Two precautions should be observed: (1) do not under any circumstances drive the pin in with a hammer; this will set up stress points at *C* (2) do not leave any tool marks on the installed cotter pin as this will also set up stress points which can cause the pin to fracture.

C V Watson Jr, *Yarmouth, Me.*

Metal fatigue will do it

Since there is no pattern of damage in *TDO*'s engine, the only conclusions that can be drawn are that failures were caused by defective pins or by metal fatigue.

Metal fatigue would be caused by poorly fitted pins moving in the keyhole. These pins should fit snugly but not so tightly that they must be hammered in.

Sometimes sharp edges of the castellations in the cap nut shear the pins. Rounding off the edges will overcome this. But in this case, since the nuts were tight, movement between the nut and the pin can most likely be ruled out.

J L Downing, *Brooklyn, N. Y.*

Your May problems

How can we measure vibration?

Our latest steam-generating cycle includes a motor-driven geared feedwater pump. Motor speed is 1800 rpm, pump speed is 6850 rpm. Pump discharges 406-F water at 2900 psig. The unit appeared to operate satisfactorily for well over a year.

During the year's operation we took periodic measurements of vibration on the bearing housings with an optical vibrometer. Readings always remained quite close to one mil, so we assumed no important vibration existed.

During our latest station outage we opened up the pump and were surprised to find internal cracking. Small incipient cracks appeared in impeller-vane fillets. We have seen enough of this kind of thing to know cracks were caused by high-frequency vibration.

Our problem: how do we get meaningful measurements of pump vibration? Obviously our old method missed. Can Power readers help us?—*HCK*

Which water-chemistry tests for us?

We have several closed-cycle cooling towers in our plant to supply process cooling. Our plant is located in the Southwest in an area not noted for its pure water.

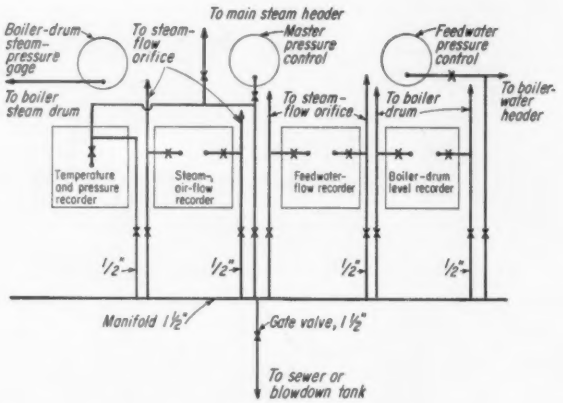
Because of local water conditions I have been very careful to monitor all possible water indicators. This includes measurements of calcium and magnesium hardness, alkalinity A, B and C, total solids by conductivity, pH, dissolved O_2 and CO_2. In addition I have been checking the Langelier-equation index once a day.

My problem is one of economizing on effort. I must cut down the number of measurements I take. So, I would like to hear from other Power readers concerning measurements they feel are most important.

Our cycle makeup runs about 3%. Makeup water contains 250-ppm calcium, 150-ppm magnesium, 140-ppm sodium, runs an alkalinity of 200, chloride content of 200, sulfate of 100, silica of 50 and a pH of 7.8. Can any reader help out?—*FBL*

Sit down right now and answer one or both problems. We'll pay extra for answers with photos or sketches

Timely **practical ideas** to help solve



Here's how we backflush instrument lines

Operating personnel who work with modern steam-flow and pressure-control instruments know the importance of blowing down meter connecting lines. But waiting for the lines to refill with condensate before the meters can be returned to service wastes valuable time.

We devised a piping arrangement, sketch, above, for backflushing all connecting lines needing frequent blowdown. Boiler feedwater is used. Piping arrangement is for the metering equipment on the back of boiler's control panel.

This flushing method has been in use for ten years. We are well pleased with its operation. We can return the instruments to service after only a few minutes' flushing, for all lines remain full of water.

Our boiler-feedwater pressure is 200-psi greater than steam-header pressure. When the steam-flowmeter and pressure-controller lines are flushed, water discharges at the steam-flow nozzle or orifice, or into the boiler's steam manifold along with superheated steam. Manifold has a steam trap, allowing all water that does not evaporate to escape.

The instrument-blowdown piping is connected to a common 1½-in. manifold with a 1½-in. drain to sewer. A valve was installed in the drain line; a ½-in. line from the boiler-feedwater pressure-gage piping also connects to the manifold.

When instrument lines require flushing, the 1½-in. valve on the manifold drain is closed; the ½-in. valve on the boiler-feedwater pressure-gage line is opened. This allows full pressure to build up in the manifold. Of course the instruments are isolated from their respective lines, and each blow valve opened for a few minutes for flushing.

Since the lines remain filled with water, instruments can be put back into service immediately. The feedwater flowmeter lines can't be flushed but are blown down in the regular way with 1½-in. manifold drain open. At present we use this flushing method biweekly, or as often as needed.

I feel a similar arrangement should be used, if possible, with all steam-control instrumentation.

L A Morris, *Willow Island, W. Va.*

Watch that lint

Marmaduke Surfaceblow's straightening out the air-conditioning system (*Marmy cools some hotheads*, December Power) parallels our experience on large generator bearings.

Some stations have a unit oiling system. Here the unit has its own self-contained setup—by far the best arrangement in my opinion. Others have central oiling systems to take care of several units—bad if something goes wrong. Most of these systems are gravity fed, the oil passing through the thrust bearing, thence to the guide bearing, from there to a sump where it goes through filter bags—usually cotton. From sump, oil is pumped back to the main tank.

One of our older stations ran into a rash of bearing troubles. I always make it a point when troubleshooting to talk with the ordinary Joe on the job—the man with the oil can in this case. Oftentimes, as here, I learn what is wrong right off the bat.

The filter bags they were using had been made from cheap flannelette and installed in place of the standard cotton bags which wore out through the years. Lint from the flannelette fouled up the wire-mesh screens. No oil flow, no babbitt after a few minutes. Money saved by this "homespun expedient": zero double zero, plus costly outage time to replace bearings.

W Buckshee, *Shawinigan S, P.Q.*

Cellophane tape is your handy plant helper

A glutton for work around your plant: that's cellophane tape. We use it for: (1) marking liquid-level lines on gage glasses (2) marking a straight line on material to be cut (3) preserving instructions, operation-sequence numbers (over paint or crayon), key identity tags (4) preserving sharp edges on tools or fine threads (5) preserving small complete-unit-replacement kits and assemblies that can be stuck on a card (6) preserving clearances on card records (leads, etc) (7) in temporary lab work, taping plugs and sockets open, on or off (8) holding cut packing-ring assemblies in nests, whipping ends of packing and lines (9) a third hand when large or irregularly shaped gaskets or seals must be fitted together on joints, flanges, heads (10) a seal on containers and in dustproofing. J King, *Brighton, Mass.*

your tricky design and maintenance problems

STEVE ELONKA, Associate Editor

Trouble-shooter's diary

One boiler house I entered had problems of furnace draft control—very amusing. The operator had a pile of bricks holding open his control damper. He claimed the damper would not operate. Bricks weighed about 35 lb. What seemed to be the trouble? He replied, "I have to put all this weight on the controller to keep smoke from coming out the doors."

Explaining that the controller had to get an impulse from the boiler itself, I asked him to open the impulse line to the boiler. We opened the 1-in. pipeline and found it plugged with soot for a distance of ten feet from the boiler. After cleaning the line, we took all the weights off. I explained that in order to get a furnace-draft controller to operate, all the impulse lines must be open. I couldn't call the operator stupid, though—no license was required in his town.

R L STOCKDALE,
Cuyahoga Falls, Ohio

Too great a differential

A boiler house was having feedwater-control trouble. The water would not stay level and the boiler continually hunted up and down. Observing the pressure of the boiler, 150 psi, and the feedwater pressure of 300 psi, I asked the operator why he carried such a high differential. He said that this way he could be sure the water would get into the boiler.

I had him cut the pressure of the water to a differential of 75 psi. The boilers settled out to a constant load. I explained that the water-regulating valve could not operate within its range without forcing too much water into the boiler and cooling it down. With a small amount continually going into the boiler the water flow and the firing equipment could work slowly but consistently and there would be plenty of water at all times.

R L STOCKDALE,
Cuyahoga Falls, Ohio

What would you have done?

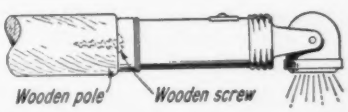
While I was employed by the U.S. Navy in a civilian capacity, the commandant wanted to know the relative humidity of a certain refrigerated walk-in cooler. With no sling psychrometer nor suitable thermometer to make one, and the next city—Denver—some 70 miles away, the time element was breathing down my neck. What to do?

My father was an advocate of the "all roads lead to Rome" theory. That gave me an inspiration. At home we used a wine glass half filled with water. We'd put in ice cubes and stir with a thermometer.

At the first sign of condensate forming on the outside of the glass, we'd note the temperature of the water. That temperature indicated the dew point of the air. Then we'd take the dry-bulb reading. Using a psychrometric chart we obtained a very close relative-humidity reading. Consequent double checks proved our readings by the wine-glass method within a tiny fraction of complete accuracy. I tried this method again for the commandant and it saved the day. What would *you* have done?

C BACHMANN, *Jamaica, N.Y.*

Now we can see into odd places

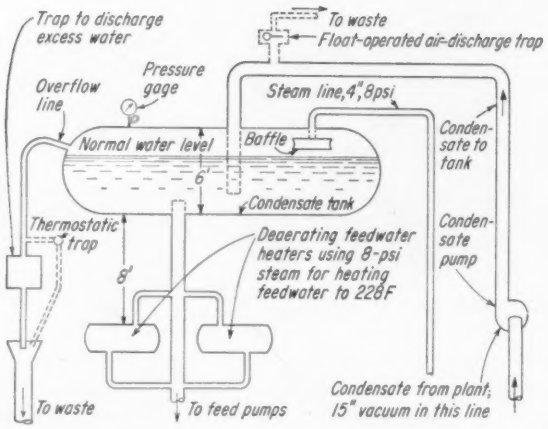


Every plant needs a handy extension handle for a flashlight to cast some light in those hard-to-reach places. As my sketch shows, the light's bottom cap is screwed onto a 12-ft extension handle. This light will come in handy when inspecting inside tanks, drums, piping, overheads—in fact almost anywhere in an emergency. A long, light wooden pole is about all you need. Keep it in a permanent place so you know where to find illumination in a hurry.

F LETTINO, *Long Island City, N.Y.*

Correction: Not –300, but –450 F

In December POWER, p 249, *Teflon O-rings find new uses,* we said that below —300 F Teflon becomes brittle. But now we learn that, according to tests made by cryogenic experts of the National Bureau of Standards and others, Teflon retains its flexibility and elongation down to —450 F. For this reason it is widely used today in cryogenic designs—bearing surfaces for liquid oxygen, fuel-line and hydraulic hose for high-flying jet aircraft, etc. OK, you low-temperature guys?



We increased condensate without raising the tank

We had to increase our exhaust pressure from 2½ to 8 psi. This would keep our most-distant space heaters from starving for steam. Our first thoughts were to raise the condensate tank or to reduce steam pressure to the feedwater heaters.

Raising the condensate tank high enough for water to flow to the heaters was impractical. But reducing the steam pressure would be unreliable because a 4-in. steam line was connected to the space above the water level in the condensate tank, sketch. So we extended the 8-psi exhaust line into this space, shown by dotted lines. Our reasoning: 8 psi above the water would supply enough head pressure to let water flow to the open feedwater heaters.

It looked like a quick, cheap solution—and one that would prove reliable. But our solution brought other problems in its wake. With about 150 space heaters in the plant, some air would always return with the condensate. This air would accumulate above the water in the tank, and when enough air gathered the steam would condense faster than it could flow through a 4-in. line.

When air, steam and water are in a closed vessel the three stratify, air occupying the center position. Our new problem was how to remove this air. We installed an air trap at the top of the condensate return line before it entered the tank. This trap removed most, but not all of the air.

We noticed the overflow line would cool off as air accumulated. So we installed a thermostatic trap, shown by dotted lines, to discharge the air into this pipe. This setup has been performing perfectly so far—we've had no trouble for two years.

C ZIMMERMAN, *Grand Rapids, Mich.*

My biggest boner

We had a 100,000-lb-per-hr spreader-stoker-fired unit. All startup work had been completed and the boiler house had been cleaned up. The way was paved for an inspection trip by some company VIP's to see the new unit under full load.

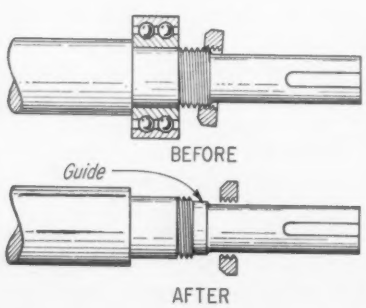
It was a hot day and the big wheels arrived right on the dot of 1 pm in their gleaming white shirts. The chief engineer, also resplendent in a white shirt, proceeded to show them around.

The automatic combustion controls had been set. But one individual, who shall forever remain nameless, decided that slightly better furnace draft control could be achieved with a small adjustment to the length of the ID-fan inlet-damper control rod.

Since this individual wanted to finish his work and be on his way, he decided to make the adjustment with the unit under load. To do it he had to lock the damper in place and loosen the rod. But somehow in the process the damper got away from him and slammed shut.

Resulting puff on the furnace made a shambles of the spic-and-span boiler house—right along with the white-shirted VIP's. No one was hurt and no particular damage done to the unit. But it took weeks to get the soot and ashes out of the boiler house.

L A WATSON, *Atlanta, Ga.*



No more crossed lock nuts—and we needn't baby them

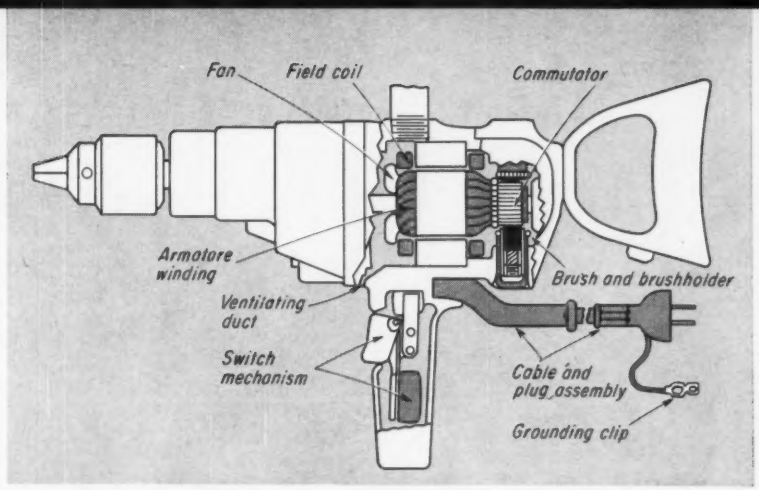
While new bearings were being mounted on the shaft of our rotary compressor, faulty handling of one of the fine-pitch-thread bearing locknuts caused it to cross the threads with its mating shaft thread, sketch above.

To avoid repetition of this occurrence on this and similar equipment, we now turn down a few of the shaft threads. New shoulder gives the nut a close-sliding fit along the mated portion of the threads, as lower sketch shows.

This produces good piloting and true positioning for the lock nuts. Now, since there's no need for "babying" the nuts to insure correct starting, careless handling cannot cross the threads.

E WITTMANN, *Villas, N.J.*

By PAUL C ZIEMKE
Clinton, Tenn.



ACCIDENTAL CONNECTION of live parts to tool frame can occur in many ways: carbon dust bridging brushholders; abrasion of loose field or armature coils; defective switch

Keep electric tools safely grounded

Because they're used under all conditions and are bound to get rough treatment, electric tools need regular attention

We have long agreed that grounding electric tools is an excellent safety practice, yet often as the philosophy is expressed, it always bears repeating. Ideally, the safest condition is completely insulating any possible conducting part from the ground. New efforts are being made to achieve this with "double-insulated" portable tools, discussed in POWER's *Today's Development* report on electrical safety in March, 1961. Success of this approach would eliminate the factor of human carelessness, always the weak spot in safety practices. But for the present, the hazard to users of conventional tools can be greatly reduced by insisting on satisfactory grounding for the tool's exposed metallic parts.

Most manufacturers furnish tools with a 3-wire cord, the green wire terminating in a battery clip for attachment to some type of ground such as a water pipe. A tag carries instructions on how best to achieve this "protective grounding". But life of the clip, used or unused, is usually short indeed! Large users of tools see that the nonpolarized 2-bladed plug-and-clip combination is replaced at once by a polarized 3-bladed plug with the top blade ¼-in. longer than its companions, the power blades. Long blade makes a ground connection in the 3-slot receptacle before the tool is energized by the other blades. By the same token, as you withdraw the plug, the power is cut off before the ground blade disconnects.

Operating with poor extension cords adds one more hazard to those of the tool. Too many people thoughtlessly assume that a cord which effectively lights an average-sized bulb will power a tool equally well. But the average lamp extension cord uses No. 16 AWG conductors, while no less than No. 14 should be used for transmitting power.

Need we mention that the cord should have three conductors, each one insulated by its own lively rubber covering, then enclosed as a whole with a tough rubber jacket? The male and female plugs should be provided with clamps to take the strain off the three wire connections. Finally, the wire ends should be dipped in solder to prevent fraying and gouging that otherwise occur under tension of the binding post. Soldering eliminates corrosion, too, so that no high-resistance areas develop to heat up under sustained loads. Exceptionally long cords will need beefing up with larger copper wire to avoid low voltage at the tool.

Electric welding on an extensive scale can upset normal ground conditions where ground is used as return circuit for the welders. If you use an electric drill on metal structures or machinery that is above actual ground potential by virtue of welding currents flowing in the metal, the tool's ground wire may carry welding current. If drilling time is more than momentary, the cord may be damaged. And it's possible that the voltage at the tool may be harmfully high, a hazard to the operator. Answer to this problem, of course, is to provide individual return conductors for welding operations, leaving the metallic ground path for abnormal currents.

Shop testing of tools must be put on a sound basis. A test for accidental grounds with a lamp in series is a waste of time. Megohmmeter test is better, but not an accurate measure of leakage. Insulation resistance between the metal frame and windings varies with temperature, humidity, cleanliness, motor size and *with the test voltage used.* Test results obtained in different shops are not necessarily comparable. Insulation-resistance checks require judgment. Testing with 250-v dc is best for 115-v equipment, and you should maintain a minimum of 300,000 ohms. Check tools periodically and put a dated band on the cord behind the plug. Meanwhile, periodic field megohmmeter tests can determine when to send tools to shop.

Another good reason for **Confidence in a growing America**

YOUR FUTURE RIDES HIGH ON THIS CURVE!

If you're uncertain about what lies ahead, take a good look at the white line. It represents America's past production rate and economists' estimates of future production, with the peaks and valleys smoothed out. Over the long pull the curve keeps rising.

In fact, American production more than doubles every 20 years.

You can expect even faster growth during the Sixties. Because at the present rate, the $12 billion a year we're spending on research and development may well reach $22 billion by 1971. The outpouring of new products and processes will be in proportion. Research is the fountainhead of progress. Ready now are such innovations as foods preserved by radiation, cleaning with sound waves, machines that can translate foreign languages, and solid radio sets without wires. And many more are on the way.

Judging by past experience, two million more businesses will be established to make and distribute our growing production during the next 25 years. Whole industries will emerge to turn out the new products that are coming from the laboratories. America has a brilliant future but to realize it fully, we must all work together for the common good.

THE PROMISE OF AMERICA

FREE—*Write for illustrated booklet, "The Promise of America." Box 10, New York 18, N. Y.*

GET READY FOR AN UPSWING!

MORE RESEARCH—We're now spending $12 billion a year—and that's expected to double during the Sixties!

MORE INCOME—Today's $6500 average per family represents an all-time high!

MORE SAVINGS—Now at the highest level ever—net savings of individuals exceed $375 billion!

MORE JOBS—Despite unemployment there are 15 million more jobs than in 1939—will be 22 million more by 1975!

MORE EDUCATION—By 1970 we'll have 20 million more high school graduates than today, and 3 million more college graduates. They'll earn more, live better!

MORE LEISURE—40 million Americans get paid vacations and there are 16 million people over 65, many of them with retirement income to spend!

MORE MARKETS—U.S. exports, plus output on U.S.-owned plants overseas, already account for over $50 billion in sales!

MORE NEEDS—Schools, hospitals, highways, homes—we need billions in improvements right now, and the need keeps growing!

ADVERTISING COUNCIL PUBLIC SERVICE

PROFESSIONAL SERVICES

CONSULTING · DESIGN · EXAMINATIONS · TRADE MARKS
CONSTRUCTION · PLANS · SURVEY · REPORTS

BLACK & VEATCH

Consulting Engineers

Electricity—Water—Sewage—Gas—Industry
Reports, Design, Supervision of Construction
Investigations, Valuation and Rates

1500 Meadow Lake Pkwy, Kansas City 14, Missouri

BURNS & McDONNELL

Engineers — Architects — Consultants

4600 E. 63rd S. Trafficway
Kansas City 41, Missouri

GILBERT ASSOCIATES, INC.

Engineers and Consultants

Design and Construction
Engineering and Economic Studies for
Thermal, Hydro and Nuclear Power
Industry • Water and Sewage

New York · READING, PA. · Washington

INTERNATIONAL ENGINEERING COMPANY, INC.

Engineers

Investigations — Reports — Design
Procurement — Field Engineering
Domestic and Foreign

74 North Montgomery St., San Francisco 5, Calif.

THE KULJIAN CORPORATION

Engineers - Constructors - Consultants

POWER PLANT SPECIALISTS
(Steam, Hydro, Diesel)
Utility • Industrial • Chemical

1200 N. Broad St. · Philadelphia 21, Pa.

PETER F. LOFTUS CORPORATION

Design and Consulting Engineers

Electrical • Mechanical • Structural
Civil • Nuclear • Architectural

First National Bank Building
Pittsburgh 22, Pennsylvania

CHAS. T. MAIN, INC.

CONSULTING ENGINEERS

Design—Construction Management
Steam, Hydroelectric & Diesel Plants
Gas Turbine Installations
Transmission—Distribution

Boston, Mass. · Charlotte, N. C.

PIONEER SERVICE & ENGINEERING CO.

Consulting & Design Engineers
Purchasing
Construction Management

231 So. La Salle St. · Chicago 4

SARGENT & LUNDY

ENGINEERS

Consultants to the Power Industry

STUDIES • DESIGN • SUPERVISION

140 South Dearborn Street, Chicago 3, Ill.

J. E. SIRRINE COMPANY

Engineers Since 1902

Consultaions • Design • Reports
Steam & Hydro Power Plants
Steam Utilization
Laboratory Analyses of Water

Greenville, South Carolina

ALDEN S. STILSON & ASSOCIATES

Consulting Engineers

Industrial & Municipal Power Plants
Surveys, Reports, Design & Supervision

Columbus, Ohio · Cleveland, Ohio

TIPPETT & GEE CONSULTING ENGINEERS

Mechanical—Electrical—Thermodynamics—Structural
Design—Studies—Supervision
Power Stations—Transmission—Distribution
Industrial Plants—Process

1333 North Second Street · Abilene, Texas
214 Meadows Building · Dallas, Texas

WATER SERVICE LABORATORIES INC.

Specialists in Water Treatment for Corrosion Prevention

Main Office
615 West 131 Street · New York 27, New York
Offices also in Phila., Wash., & Richmond, Va.

NO TIME TO EXPERIMENT . . .

So why not save time by calling in a specialist who knows the ground you are exploring?

POWER, meeting place of power men in all parts of the country, points the way to the solution of many power problems through its Professional Service Section.

SEARCHLIGHT SECTION

(Classified Advertising)

EMPLOYMENT · BUSINESS EQUIPMENT — USED OR RESALE
OPPORTUNITIES

DISPLAYED RATE

The advertising rate is $20.50 per inch for all advertising appearing on other than a contract basis. Contract rates quoted on request.

Emplomeni Opportunities $52.00 per inch, subject to agency commission.

An advertising inch is measured ⅞" vertically on one column, 3 columns—30 inches —to a page.

UNDISPLAYED RATE

$2.10 a line, minimum 3 lines. To figure advance payment count 5 average words as a line.

Positions Wanted undisplayed advertising rate is one-half of above rate, payable in advance.

ADDRESS BOX NO. REPLIES TO:
Box No. Classified Adv. Div. of this publication.
Send to office nearest you.
NEW YORK 36: P. O. Box 12
CHICAGO 11: 520 N. Michigan Ave.
SAN FRANCISCO 11: 255 California St.

POSITION VACANT

Mechanical Engineer—Experienced in design and maintenance of industrial heating, air conditioning and steam distribution systems for a large medical research center. Excellent opportunity to grow with organization. Beginning salary $8,955. Federal Civil Service Merit System position with all retirement, leave and insurance benefits. Relocation expenses reimbursed. Write Mr. Ross Holliday, Plant Engineering Branch, National Institutes of Health, Bethesda 14, Maryland.

POSITIONS WANTED

Chief Engineer, age 39, technical education, 15 years experience in the operation, maintenance, construction, and betterment of turbo-electric power plants. PW-6183, Power.

Operation and Training Supervisor—20 years experience with turbo-electric plants. Various plant startup experience—Howard Houk, 229 South Scott, New Orleans, La.

POWER ENGINEER

Young mechanical or power engineer, preferably with some industrial power plant experience, wanted for integrated boxboard mill-carton plant operation in Central Illinois. Good possibilities for right man. Paid Pension-Health Welfare Plans—other benefits. State experience—salary desired, etc.

P-6531, POWER
520 N. Michigan Av., Chicago 11, Ill.

POWER TRANSMISSION AGENTS!

New and improved flexible coupling design now in pilot production by an 80 year old manufacturer with AaA rating. Excellent potential for aggressive and knowledgeable representation. Full advertising, promotion and application-engineerig support. Submit complete details of area and accounts served, size and technical qualifications of sales-engineering staff etc. to

RW 6529, POWER
Class. Adv. Div., P.O. Box 12, N. Y. 36

SALES ENGINEERS

Leading Water Treatment Company has several openings in key territories. Chemical background or power plant experience required. Write to:

Mr. M. E. Reiner, Division Manager
E. F. DREW CO., INC.
15 E. 26 St., New York 10, N. Y.

SEARCHLIGHT SECTION

(Classified Advertising)

EMPLOYMENT: BUSINESS: "OPPORTUNITIES" EQUIPMENT: USED OR RESALE

INSTRUMENT ENGINEERS

Major west coast engineering and construction firm has openings for senior engineers experienced and qualified in instrumentation and/or systems engineering. To assume full job responsibility on a project level for the instrumentation and control of processing, industrial and power plants. Would prefer experience in electronic control and digital information systems.

Relocation allowances cover moving costs plus transportation reimbursement for you and members of your family. If you have an interest in a San Francisco assignment, please send a resume of experience, including your present and required salary, to George I. Copeland, Manager of Personnel. A personal interview will be arranged for qualified applicants.

BECHTEL CORPORATION
220 Montgomery St.
San Francisco, California

MECHANICAL ENGINEERS

Project level positions open in both Chicago and New York offices of established consulting engineering organization. Minimum qualifications: BSME degree, power option, 10 years experience in design of steam-electric generating stations; ability to perform all calculations and write specifications for equipment, controls and installation contracts. Duties include supervision and manpower control of mechanical design-drafting group. Balanced personality required for client contact and internal coordination. Career opportunity and possibility for eventual ownership participation. Submit two copies of complete resume.

P-6351, POWER
520 N. Michigan Ave., Chicago 11, Ill.

ELECTRICAL ENGINEER

Excellent permanent position with large corn wet milling company.

Work involves planning and designing industrial electrical power distribution, power utilization, lighting, and control systems.

B.S. degree required. One to three years' experience preferred.

Send replies which will be held in strict confidence to

Personnel Department
CLINTON CORN PROCESSING COMPANY
(A division of Standard Brands Inc.)
Clinton, Iowa

GRADUATE MECHANICAL ENGINEER

With Power Plant experience to work as Utilities Engineer in Plant Engineering Department of large pulp and paper mill. Job will consist of engineerig assignments of additions, alterations, replacements, changes, and studies necessary to upgrade and improve operation of plant utility equipment. Job will require close coordination with power plant operating personnel. Age 25-35. Send complete resume to:

Personnel Manager
SCOTT PAPER COMPANY
Mobile, Alabama

MECHANICAL SPECIFICATIONS WRITER

Capable man with broad experience in specification writing for mechanical phase of building construction work is sought immediately by large Midwest consulting firm. Moving expenses paid. Resume showing educational background, experience, and personal qualifications should be sent to

P-6355, POWER
520 N. Michigan Ave., Chicago 11, Ill.

MECHANICAL ENGINEERS

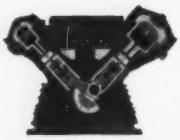
Immediate opening for Project Manager and Project Engineer experienced in design of power plants; piping; and heating, ventilating, and air conditioning. Extremely wide variety of work with established Midwest consulting firm. Permanent. Good starting salary, advancement, and vacation program. Moving expenses paid. Send complete resume to

P6549, POWER
520 N. Michigan Ave., Chicago 11, Ill.

LARGE CHEMICAL PLANT OFFERS CHALLENGING POSITION AS POWER SUPERINTENDENT

Experience in all phases of power and power production necessary. Must be fully capable of assuming top supervisory rank. College degree in Mechanical, Chemical, or Electrical Engineering preferred.

Send complete resume to:
Personnel Dept.
NATIONAL ANILINE DIVISION
ALLIED CHEMICAL CORPORATION
1051 So. Park Ave., Buffalo 10, N. Y.



ANSWER

to Worthington Hidden Value Puzzle

The fictitious "hidden value" on the back cover is, of course, the "Articulated Connecting Rod." This design is found only on light duty compressors with single acting cylinders.

The true Worthington connecting rod construction is shown above. Each rod is directly mounted on the main crankshaft, giving greatest bearing area and stronger linkage. There are fewer parts in all, maintenance is simpler and lubrication is less complex. Worthington Corporation.

WE PAY $ CASH $ FOR

Electric Motors • Starters • Transformers
Circuit Breakers — Electric Supplies
ALLIED ELECTRIC CO.
710 N. MAIN ST., MEMPHIS, TENN.
BOX 1838 — PHONE JA 7-1681

Circle 500 on Reader Service Card

We own and offer Power generating equipment

1—1785 KVA vertical Skinner engine
1—1250 KVA West. condensing-extraction turbine
1—875 KVA horizontal Skinner engine
1—625 KVA Worthington non condensing turbine
1—715 KVA West. non condensing turbine
1—500 KVA G.E. non condensing

Steam coditions on above vary from 140 to 400 lbs. 750 degrees.

WHITE ELECTRIC MOTORS
LOWELL, MASS.

Circle 501 on Reader Service Card

UNUSED SUB STATION

3750 KVA Westinghouse Transformer
High Voltage—24,100/23,500/22,900/22,300/21,700
Low Voltage—2400/4160
Complete with Primary Breaker and Four 1200 Amperes
Air Blast Breakers for Secondary
Photos and Complete Description Available.

EMPIRE ELECTRIC CO., INC.
5200 FIRST AVE., BROOKLYN 32, N. Y.
HYacinth 2-5555

Circle 502 on Reader Service Card

DUAL-FUEL POWER PLANTS

2360 KW Nordberg, 21½" x 31"; 225 RPM; New '52; 36,000 Total Hours; 3/60/4160V, Full Load Test BTU Per KWH, 9316 as of 12-60. Priced F.O.B. Midwest at $257,000.00.

2—1000 KW, New; Electro-Motive Division, G.M.C.; Skid Mounted 16-567-C Engines, @ 720 RPM, complete with all accessories; 3/60/2300/4160V Heat Exchanger Cooled, Less Switchgear; $87,700. each, F.O.B. Cars, Midwest; 12 Months Warranty.

Preston W. Duffy & Son
193 E. Beck St., Columbus 6, Ohio

Circle 503 on Reader Service Card

Wanted For Export—Used

Motor Generator, 2000 or 2500 H.P. Synchronous Motor, 2200V, 3 ph. 60 cy. Generator 250V D.C.

B & W Sectional Header Boilers, 500 to 1200 H.P.

Non-condensing Turbo Electric Generators, 500 to 1500 K.W.

OFFERED

Factory new Turbo-Electric Generator, 22,000 K.W. 13800V, 3 ph. 60 cy. 3600 RPM, 850 PSIG, 900°F.

MACHINERY EXPEDITERS
170 Broadway, New York 38, N.Y.
Our 20th year.

Circle 504 on Reader Service Card

FOR SALE

1—B&W, Type H, 3-Drum, 300 HP, Steam Boiler in good operating condition. Normal operating steam pressure 125 PSIG, maximum 140 PSIG. Boiler being removed only to make room for larger unit. Can be put into operation at any time. Will produce 15,000 pounds of steam per hour. Priced for quick sale. Boiler can be seen in Steam Plant, SOUTHERN METHODIST UNIVERSITY, DALLAS, TEXAS.

Circle 505 on Reader Service Card

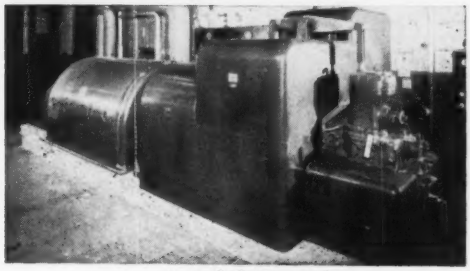
Modern 850lb. 850°—6250 K.V.A. Turbine Generator

80 to 160 lb. Back Pressure

Immediately

Available

Excellent Condition



Actual Photograph

Generator

3/60/2400, 80% P.F.

Built by Westinghouse

Other turbine Generators

1-2000 KW GE	600#750° Non-Cond. 150# BP 4160V/6600V
2-3000 KW Westinghouse	600# 750° Non-Cond. 125/150# BP 2400V
1-3000 KW Westinghouse	400# 750° Cond. 6600/4160V
1-2500 KW Westinghouse	125# Non-Cond. 10# BP 2300V
1-6000 KW GE	200# Condensing 2300V
1-7500 KW Allis-Chalmers	850# 850° Non-Cond. 110# BP.

1—33,000 KW General Electric 950 lbs. 950°, 3/60/13,800 Volts

Cable Address: CHASWEAVER

CHARLES WEAVER, INC.

19701 JAMES COUZENS HIGHWAY

DETROIT 35, MICHIGAN

Telephone: BRoadway 3-1900

Circle 506 on Reader Service Card

DIESEL GENERATOR SETS

(4) NEW 500 KW GM 8-278

Engines — 715 HP — Vee type — 8 cylinder — 8½ x 10½ — air starting — 720 RPM — 2 cycle — heat exchanger cooled. Engines drive 500 KW Allis-Chalmers D.C. generators—120/240 — 2080 amps — 720 RPM — compound wound. Complete with a very generous supply of spare parts. IF YOU NEED D.C. POWER, NOTHING CAN BEAT THIS VALUE. FULLY GUARANTEED.

NOTE:

We can also quote you using the above engine — radiator cooled and with an A.C. generator — either 440/2300 or 4100 — and offer a completely portable unit.

EXCELLENT GENERATORS FOR STANDBY POWER

(1) UNUSED 250 KW UNIT

440/3/60 — 900 RPM Westinghouse generator — driven by a Cooper-Bessemer 8¾ x 11 engine model F.S.6 — Heat exchanger cooled. This is an unused set in prime condition. Will demonstrate. Unit is a slow-speed heavy duty diesel generator.

(4) AS ABOVE, RECONDITIONED

With Switchgear

Send us your inquiries

THE BOSTON METALS CO.

313 E. Baltimore St., Baltimore 2, Md.

ELGIN 5-5050 LEXINGTON 9-1900

Circle 507 on Reader Service Card

38 Years Dependable Service

SLIP RING MOTORS 3 Ph., 60 Cy.

H.P.	Volts	Make	Speed
500	4000/2300	G.E	600
450	4000/2300	G.E.	1200
400	2300/440	G.E	600
400	4000/2300	Whse.	720
300	4000/2300	G.E	720
300	440	Whse	3600
250	4000/2300	Al. Ch.	600
200	2300	G.E.	600
200	2300/440	G.E.	720
150	440/220	G.E.	1800
150	2200/440	Whse.	720
125	2300	G.E.	600

AC GENERATORS or SYN MOTORS, 60 Cy.

H.P.	Volts	Make	Type	R.P.M.
400	2300	G.E.	TS	1800
400	2200/440	G.E.	ATI	720
300	2200/440	G.E.	TS	1200
300	440	G.E.	TS	720
150	440/220	Whse.	G	1200

SQUIRREL CAGE MOTORS

500	2300/4000	G.E.	FT	1200
500	2200/4000	Elliott	SC	1800
400	2300	G.E.	FT	3600
400	2300/4000	G.E.	K	1200
350	2300/4000	G.E.	SEDP	3600
350	2300/4000	G.E.	K	600
300(2)	2300	G.E.	FT	3600
300	2300/4000	L. Allis	FS	1800
300	2300/400	G.E.	KT	600
250	2300/4000	G.E.	K	720
250	2300/440	G.E.	K	1200
200(2)	440	G.E.	Dr-Pf.	720
200	2200	G.E.	KT	1800
200	2200	Cont.	TEFC	3600
150	440	El. Mchy.	Dr-Pf.	900
150	440	Whse.	X-pf.	3600
150	440/220	Cont'l.	X-pf.	1800
150	440/220	G.E.	TEFC	720
150	2200/440	G.E.	TEFC	3600
125	2200/440	G.E.	FT	1200
100	440	Whse.	TEFC	3600
100	440	Cont.	X-pf.	1800
100	2200	G.E.	FT	900

CIRCUIT BREAKERS, 3 Pole

2—1600 Amp., G.E., AL-50, 600 V., Air
1—1600 Amp., G.E., AL-50, 600 V., outdoor
1—1200 Amp., Whse., F-124, 7.5 KV, manual
1—600 Amp., G.E., 15 KV, Sol. oper.
1— 600 Amp., Whse., 7.5 KV, outdoor, New.

D. C. MOTORS

H.P.	Volts	Make	Type	Speed
150	230	El. Dyn.	B/brg.	800
140	230	G.E.	CD	830
90	230	G.E.	CD	1750

MOTOR GENERATOR SETS

KW	Make	Input., AC	Motor Type	Output V., DC
300	Whse.	4150/400	Syn.	250/125
150	G.E.	440/220	Syn.	250
125	G.E.	440/220	Sq. Ca.	125
100	G.E.	2200/440	Syn.	250
65	G.E. B	2200/440	Sq. Ca.	250

TRANSFORMERS 60 Cy.

3—500 kva, G.E., 13,800—240/480 V.
3—200 kva, Mol., 13,800—2300 V.
3—333 kva, G.E., 13,800—2400 V.
3—333 kva, G.E., 2400—240/120 V.
3—333 kva, Whse., 2400/4160Y—240/480 V.
1—300 kva, Whse., 4160—480 V., Dry, New
3—250 kva, Whse., 2400/4160Y—240/480 V.
3—200 kva, G.E., 2400—460V. Pyr.
3—200 kva, G.E., 13,800—480 V.
3—200 kva, G.E., 4156—480/240 V.
2—167 kva, Whse., 4156—480 V.
3—150 kva, Al. Ch., 2400—220 V.
3—150 kva, G.E., 13,200—2300 V.
1—150 kva, Whse., 4160—120/208Y V., 3 ph. Dry New
3—100 kva, Whse., 2400—240/480 V., Dry
3—100 kva, G.E. 2400—120/240 V., Pyr.

only partial listing

STEPHEN HALL & CO.

HARRY J. RICE, Pres.

625 ADAMS ST., HOBOKEN 2, N. J.

Circle 508 on Reader Service Card

HI PRESSURE BOILERS 10-5000 H.P.

USED—NEW—PURCHASED—SOLD—RENTED

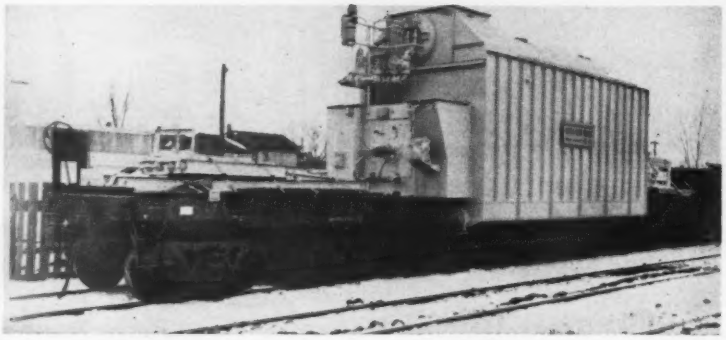
Large and Complete Inventory for Domestic and Export

Indeck Power Equipment Co. 9750 N. Skokie Blvd.—Chicago (Skokie) Illinois—OR 3-7666

Circle 509 on Reader Service Card

NEW—UNUSED—ASSEMBLED

88,000 LBS/HR -- 235 PSI.



Union Iron Works package type water tube boiler, model MH-T, rated at 88,000 lbs/hr.—235 psig assembled, and delivered new in 1960—never placed in operation—steel encased and capable of being shipped intact aboard RR car without dismantling. IMMEDIATE DELIVERY. Fully equipped.

INDECK POWER EQUIPMENT CO.

9750 N. Skokie Blvd. Chicago (Skokie), Illinois

ORCHARD 3-7666

Circle 510 on Reader Service Card

BOILERS

From the unfinished Battle Cruiser "Hawaii"

Material installed completely and never used.

8 Babcock & Wilcox Watertube Boilers

Approximately 157,000 lbs/hour. Working pressure 600#—850° T.T.—Oil-fired—with all boiler trim. Units are complete with fuel oil burning equipment—feed water pumps—feed water heaters, etc. Units are in prime condition.

CAN BE LOADED AS A UNIT OR DISMANTLED AND SHIPPED IN SMALLER SECTIONS

THE BOSTON METALS CO.

313 E. Baltimore St., Baltimore 2, Md.

ELGIN 5-5050 — LEXINGTON 9-1900

Circle 511 on Reader Service Card

OPPORTUNITIES!

in

New and used equipment recently released from service by a number of electric and gas utility companies

POWER PLANT EQUIPMENT
CONSTRUCTION EQUIPMENT
SUBSTATION EQUIPMENT
TRANSMISSION LINE MATERIALS

Send for new list . . . to

EBASCO SERVICES INCORPORATED

APPARATUS EXCHANGE

Two Rector St., New York 6, N. Y.

Circle 513 on Reader Service Card

FOR SALE

1—3000 KW, 25 cycle Condensing Turbine Generator, General Electric.
2—300 KW, 25 cycle, Diesel Generators General Motors.

Immediately Available—Excellent Condition

The Kaiser-Nelson Steel & Salv. Corp.
6272 Canal Road, Cleveland 23, Ohio
LAfayette 4-1471

Circle 512 on Reader Service Card

MOTORS • GENERATORS
TRANSFORMERS
NEW • REBUILT

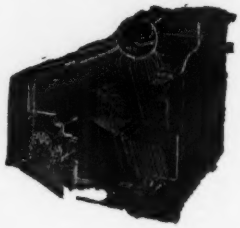
ELECTRIC EQUIPMENT CO.

WORLD'S LARGEST INVENTORY
CALL COLLECT CL 4-9058
P. O. BOX 51 • ROCHESTER 1, N. Y.

Circle 514 on Reader Service Card

BOILERS

NEW UNASSEMBLED



# Steam/hr.	Key	PSI	Temp.
122,500	DF	565	850
121,650	DF	565	850
60,000	SF	435	750
74,000	H	280	300
55,000	A	240	—

DF Double Furnace, SF Single Furnace (illustrated), bent water tube boilers w/economizers and superheaters, B & W's and Foster Wheelers.

H Header type, straight tube, B & W.

A 3 drum, single furnace, Wickes.

Polnik-Loconti Industrial Supply, Inc.

315 Oriskany St., Yorkville, N.Y.

Utica, N. Y. Ph. RE 6-4621, RE 2-4513

Circle 515 on Reader Service Card

GAS - DIESEL UNITS

2—1250 HP WORTHINGTON NATURAL GAS OR DIESEL ENGINES, 8 CYL. 700 KW GEN. ELEC. 327 RPM, 3/60/2400 V. GENERATORS. WOODWARD GOVERNORS. SWITCHBOARDS, CONTROLS, ACCESSORIES.

1050 HP FAIRBANKS-MORSE DIESEL, MODEL 32, 7 CYL. 257 RPM. 726 KW F-M 3/60/2400 WITH EXCITERS, SWITCHBOARD, ACCESSORIES. CHEAP.

WHISLER EQUIPMENT CO.
1908 Railway Exhange Building
St. Louis 1, Mo.

Circle 516 on Reader Service Card

COMPRESSORS

No better values at any price

100 CFM	150 PSI 6x7 Ing. ES-1
138 CFM	100 PSI 7x7, Ing. ES, CP & Joy
288 CFM	100 PSI 9x9 Ing. Worth. CP
294 CFM	125 PSI 9x9 Joy WG 9
321 CFM	125 PSI 10x11 Ing. ES-1
344 CFM	1500 PSI Ingersoll ES-3
351 CFM	350 PSI 11-5x11 CP ICB-2
465 CFM	100 PSI 12x11-1R-ES-1" Chic. P.T.
502 CFM	125 PSI 12x13 Worth HB
593 CFM	125 PSI 13½-8½x8 Worth DC2
640 CFM	3000 PSI Worth. DC-4
686 CFM	100 PSI 14x13 Ing. ES
877 CFM	125 PSI 17-10½x14 IR. XRB
1290 CFM	125 PSI 13-8x7 Joy WN 114 E 200 HP 3-60-220 or 440 Volt
1200 CFM	110 PSI 26/15x18 Chicago Pneumatic OCE .8PF 350 HP Syn. 3/60/4160

AMERICAN AIR COMPRESSOR CORP.
48th & P, North Bergen, N.J. UN 5-1397

Circle 517 on Reader Service Card

FOR SALE

1050 KVA DIESEL UNIT

1050 KVA Nordberg supercharged diesel engine generator unit, 3 phase, 60 cycle 2400 volts, 327 RPM.

New 1947 — Excellent condition.

The above unit is still installed and complete with all auxiliaries as in operation. Can be adapted for dual fuel operation.

International Power Machinery Co.
1612 Union Commerce Bldg.—MAin 1-9514
Cleveland 14, Ohio

Circle 518 on Reader Service Card

TRANSFORMERS—60 CYCLE

QU.	KVA	MAKE	TYPE	PHASE	VOLTAGE
2	3000	Moloney	TCB	3	7200-4160/2400
2	3000	G.E.	OA-T	3	26,400-4160/2400
1	1500	West.	O.I.S.C.	3	26,400-480 taps-hi
2	300	G.E.	K.S.T.Q.	1	4150-2406
1	300	Penna.	OA Askarel	3	12,470Y/7200-240
3	200	Amer.	C.C.	1	4160/7200-240/480
3	200	G.E.	HS-W2S	1	2400/4160-240/480
3	100	Wagner	HE	1	2300/4160-220/440
3	75	G.E.	H-form KF1		2400/4160Y-120/240
3	50	G.E.	H-form K	1	2400/4160Y-220/440
3	50	Niagara	Dry-air	1	2400/4160Y-120/240
3	50	Harrison	Dry-air	1	2400/4160Y-220/440

MOTOR GEN. SETS

QU.	KW	MAKE	SPEED	D.C.	A.C.
1	1000	West.	720	600	2300/4160 S.R.
1	400	West.	1200	250	3 unit 4160 V. syn.
1	300	G.E.	1200	250	2300/4160 syn.
1	300	Al. Ch.	1200	125/250	3 unit 440 syn.
1	175	West.	1200	125	4160 syn.
1	100	West.	900	230	4160 syn.
1	45	G.E.	1170	30	440V Sq. Cage
2	30	G.E.	1760	230	440V Sq. Cage

D.C. MOTORS—230 VOLT

QU.	HP	MAKE	SPEED	TYPE
1	350	G.E.	1200	ped. type
1	30	West.	1750	SK-113
1	30	G.E.	2200	CD-85
1	15	Crocker Wh.	1750	CCM, TEFC

SLIP RING MOTORS

QU.	HP	MAKE	SPEED	TYPE	VOLTS
1	500	G.E.	450	MT-422Y	2200
1	450	West.	1800	CW 4-30-9	220
1	350	West.	1800	CW	2300
1	300	G.E.	1170	1-15 A	4150
1	200	West.	585	CW	440
3	150	Al. Ch.	1760	AY-RW	2300
2	150	G.E.	590	1-16	4000
1	100	West.	1770	TEFC B.B.	220/440
1	75	West.	1160	CW 607	220/440
1	75	West.	600	CW 774C	220
1	50	G.E.	570	MT 552	220/440

SQUIRREL CAGE MOTORS—3 phase—60 cyc.

QU.	HP	MAKE	SPEED	TYPE	VOLTS
1	300	Al. Ch.	1200	TRW	2200
1	300	G.E.	1800	6336S B.B. Drip	4160/2400
1	275	G.E.	1180	KT 550BS	2200
2	250	G.E.	1790	KTEFC B.B.	2300
2	150	G.E.	1780	K 6323-S XP B.B.	440
2	100	Cont.	3570	NP 585-S XP B.B.	440
1	75	Cont.	3565	NP5058X XP B.B.	440
1	75	G.E.	875	KT 552Y	440
1	50	G.E.	3530	KF 405Y Vert.	220/440
1	50	Cont.	3530	NP 445X XP B.B.	220/440

MOTORS—SYNCHRONOUS 3 ph, 60 cyc.

HP	SPEED	MAKE	TYPE	VOLTS
325	900	West.		2300
400	450	West.	HB	440
300	720	El. Mh. TEFC		2300
200/100	720/360	West.		4150
150	3600	G.E.	TS 956Y drip	2300
150	1800	G.E.	TS	220/440
150	900	West.		220/440
125	900	G.E.	TS 7536	2300
125	600	G.E.	TS 7641	2200
75	1200	Cr. Wh.	ALT B.B.	220/440

FOR POWER
J.L. HEMPHILL & CO.
1603 54th STREET, NORTH BERGEN, N. J.
PHONE NEW YORK—LONGACRE 5-3227
PHONE NEW JERSEY—UNION 3-3600

Circle 519 on Reader Service Card

DIESEL ENGINES

1 HEAVY DUTY NORDBERG

Type TSM—model 32118—1700 HP @ 180 RPM — 21½" x 29". Unit complete with all pumps and coolers. Can be used for generator drive, producing 2400 HP @ 225 RPM. Equal to new. Presently in Maritime Academy.

1 UNUSED G.M. 12-278A

1200 HP — 8¾" x 10½" — 12 cylinder — VEE type — 2 cycle — 750 RPM — left hand — serial 50428. Excellent unused and fully guaranteed late type engine.

THE BOSTON METALS CO.
313 E. Baltimore St., Baltimore 2, Md.
ELGIN 5-5050 — LEXINGTON 9-1900

Circle 520 on Reader Service Card

If there is anything you want that other readers can supply
OR . . . something you don't want— that other readers can use—
Advertise it in the
SEARCHLIGHT SECTION

MISS POWER EQUIPMENT SAYS,
"For BIGGER SAVINGS and BETTER SERVICE, Get Our BARGAIN PRICES on Guaranteed NEW and REBUILT MOTORS"

SQUIRREL CAGE MOTORS
NEW AND GUARANTEED

HP	Make	REBUILT	Type	Speed
500	G.E.	S.B. Open	IK	1200
400	West.	B.B. Drip	CSP-631	1800
400	L.A.	B.B. Splash		1800
400	G.E.	S.B. Open	IK	1200
400	West	S.B. Open	CS	900
300	L.A.	B.B. Splash	FX-1485	1800
300	G.E.	S.B. Open	IK	1800
300	Reliance	B.B. Drip	AA-6085	1200
300	G.E.	S.B. Open	IK	900
300	Cont.	B.B. Splash	N-804	900
300	G.E.	S.B. Open	IK	720
300	G.E.	S.B. Open	KT-561	720
300	G.E.	S.B. Open	IK	600
250	G.E.	S.B. Open	KT	1800
250	L.A.	B.B. Splash	FX-138	1800
250	West.	B.B. Splash	CS-877	1200
250	L.A.	B.B. Splash	FX-137	1800
250	G.E.	S.B. Open	IK	1200
250	G.E.	S.B. Open	IK	900
200	G.E.	B.B. Open	K-6335	900
200	G.E.	S.B. Open	IK	720
200	L.A.	B.B. Drip 2200 v.	OGX-118	1800
200	West.	S.S.B. Open	CS-855	1800
200	West.	S.B. Open	CS	1200
200	G.E.	S.B. Open	IK-15	1200
200	G.E.	S.B. Open	IK-15S	1200
200	G.E.	S.B. Open 2200 v.	IK	1200
200	G.E.	S.B. Open	IK	900
200	A.C.	B.B. Open	AR-826	1200
150	U.S.	B.B. Splash	SC-584	1800
150	West.	TEFCBB	CS-871.5	1800
150	G.E.	S.B. Drip	K-6324	1800
150	Al. Chal.	B.B. Open	AR	1800
150	West.	S.B. Open 2200V	CS	1800
150	West.	B.B. Drip	CS-772	1200
150	West.	TEFCBB	CS-775	1200
150	G.E.	B.B. Open	KT	1200
150	G.E.	B.B. Open	KT-557	1200
150	Al. Chal.	B.B. Open	AR-826	900
150	Cont.	TEFCBB	N-743-X	900
150	Al. Chal.	TEFCBB	AZ	900
150	F.M.	B.B. Open	H-24A	900
150	G.E.	S.B. Open	IK	900
150	G.E.	S.B. Open	IK	720
125	G.E.	TEFCBB	K	3600
125	Burke	B.B. Open 440 Volt	N-505	3600
125	Reliance	T.E.F.C. B.B.	AA-5084	1800
125	G.E.	S.B. Open	IK	1800
125	G.E.	B.B. Splash	K-505	1800
125	Al. Chal.	B.B. Open	AR	1800
125	Reliance	B.B. Drip	AA-5084	1200
125	G.E.	S.B. Open	KT-553	1200
125	Century	B.B. Drip		1200
125	G.E.	B.B. Open	IK	1200
125	F.M.	B.B. Open	H	900
125	G.E.	S.B. Open	IK	720
125	G.E.	S.B. Open	IK	600
100	G.E.	B.B. Splash	K-445	3600
100	Al. Chal.	T.E.F.C. B.B.	ARZ-823	3600
100	C.W.	B.B. Open 2300 Volt	SC-445	3600
100	West.	B.B. Splash-New	CS-505	1800
100	Reliance	T.E.F.C.B.B. New	AA-445U	1800
100	G.E.	S.B. Open	KT-343	1800
100	G.E.	B.B. Open	K-504	1800
100	Cont.	TEFCBB XP	NP-505	1800
100	Al. Chal.	B.B. Drip	ARW-823	1800
100	G.E.	S.B. Open	KT-347	1200
100	Ideal	B.B. Drip New	A-584	1200
100	West.	B.B. Open	CS-607	1200
100	West.	S.S.B. Open	CS-754-C	900
100	Al. Chal.	T.E.F.C. B.B. XP	23E8	900
100	F.M.	B.B. Open	H20C	900
100	Al. Chal.	B.B. Open	AR-823	900
100	F.M.	B.B. Open	H	720
100	F.M.	B.B. Open	H	600
75	West.	B.B. Open	CS-445	1800
75	Reliance	TEFCBB	AA-504	1800

CASH FOR YOUR SURPLUS
SEND YOUR LIST TODAY!
NEW & USED Electrical Equipment

FREE CATALOG. This is a partial listing. We are continually changing our stock, and can fill your requirements at any time. Send for our free catalog. In Stock, fractional horsepower up to 500.

Motors, Control Equipment, AC and DC Generators, MG sets and transformers.
PHONE or WIRE us COLLECT
LARGE LINE of SLIP RING MOTORS & CONTROLS.

POWER EQUIPMENT CO.
8 CAIRN STREET • PHONE BEverly 5-1662 • P. O. BOX 534 • ROCHESTER 2, N. Y.

Circle 523 on Reader Service Card

FEATURED ITEMS

BOILERS
44500 #/hr CE 450 PSI @ 750°F NEW
35000 #/hr CE 285 PSI @ 577°F NEW
18000 #/hr Keeler CP 160 PSI
620 #/hr Cyclotherm 250 PSI

MOTORS—Class I Group D
350 HP Al. Ch. 3/60/2300/450 RPM
250 HP Cont. 3/60/2300/720 RPM
250 HP Al. Ch. 3/60/2300/3600 RPM
250 HP G.E. 3/60/2300/3600 RPM
200 HP G.E. 3/60/2300/3600 RPM
150 HP Al. Ch. 3/60/2300/3600 RPM

AIR COMPRESSORS
7500 CFM @ 42.5 PSIG Al. Ch. Cent. 1250 HP
1360 CFM @ 35 PSI Worthington YO 150 HP

TRANSFORMERS
2000 KVA Al. Ch. 33000—2400 3/60—(2)
500 KVA Al. Ch. 2400—480 3/60
6000 KVA 44000—4160 3/60 Substation

NATURAL GAS ENGINE GENERATORS
(Can be seen running)
1250 KVA Rathburn Jones—3/60/2400-4160

GENERATOR SETS
1250 KVA G.E. 3/60/2300/3600 Cond. 200 PSI
540 KW West. any Voltage—Cond. 200 PSI
750 KW 3/60/2200/900 RPM 250 V DC MG Set

HEAT & POWER CO. INC.
60 East 42nd St., New York 17, N.Y.
310 Thompson Bldg., Tulsa 3, Okla.

Circle 521 on Reader Service Card

THERMAL POWER STATIONS
PROJECT SUPERINTENDENTS
ASSISTANT PROJECT SUPERINTENDENTS
Civil — Mechanical — Electrical
START AND TEST ENGINEERS
SHIFT OPERATORS
LOCATION FAR EAST
Qualified applicants submit resume to
THE KULJIAN CORPORATION
Construction Division — Dept. A
1200 N. Broad St.—Philadelphia 21, Pa.

Circle 522 on Reader Service Card

ELECTRICAL POWER EQUIPMENT

SQUIRREL CAGE MOTORS
3 ph. 60 cy. 220 or 440 volts
(*2200 volts or higher)

HP	RPM	MAKE	VOLTS	TYPE
1500	1800	Al.-Ch.	2300	Ventilated
1250	3600	Al.-Ch.	4000	DP/PF
800	600	West.	2300	CS-44
600	600	West.	2300	CS-12
500	1800	G.E.	2300	KT-568Y
500	1200	G.E.	2300	FT-567
350	3600	Cr.-Wh.	440	SO-68
350	1200	West.	440	CS-22556H
200	900	West.	440	CS-8748
200	720	G.E.	440	KP-5648

SLIP RING MOTORS
3 ph 60 cy 220 or 440 volts

HP	RPM	MAKE	VOLTS	TYPE
1500	514	Al.-Ch.	2300	Mill
1000	1200	Al.-Ch.	4000	Any
1000	900	Al.-Ch.	2300	Any
600	1800	G.E.	4160	M-6345-S
500	1200	G.E.	440	M-6345-Z
500	900	G.E.	440	IM
350	1800	Al.-Ch.	2300	ARY
250	720	G.E.	4000	IM
200	720	G.E.	2300	MT-546

MOTOR GENERATOR SETS

KW	MAKE	MOTOR GENERATOR A.C.V.	D.C.V.
1750	G.E.	4160/2300	250/300
1000	West.	4160/2300	250
750	G.E.	4160/2300	250
600	G.E. (3 unit)	2300/440	125/250
500	G.E.	2300	250
400	Al.-Ch.	2300/440	125/250
250	G.E.	2300	250

50 YEARS 1910-1960 SERVICE TO INDUSTRY

Write for current complete stock lists on electrical power equipment you need or send your list of surplus and used equipment for our offer.

Phone CAnal 6-2900

CHICAGO Electric Co.
1320 W. CERMAK ROAD • CHICAGO 8, ILL.

Circle 524 on Reader Service Card

MOTOR GENERATOR SETS

Q	KW	MAKE	D.C.	A.C.	RPM
3	750	G.E.	250	3/60	720
1	500	Elliott	125	3/60	720
2	300	G.E.	250	3/60	1200
1	150	West.	250	3/60	1200
1	100	Star	250	3/60	1200

STEAM- TURBO- GENERATORS 3/60

Q	KW	MAKE	TYPE	I.S.P.	YEAR
1	10000	West.	Cond.	275	1932
1	7500	G.E.	Cond.	275	1948
2	7500	West.	Cond.	400	1945
1	5000	West.	Cond.	400	1938
1	5000	West.	N. Cond.	850	1941
1	3000	G.E.	Cond.	400	1940
1	2500	G.E.	N. Cond.	180	—
1	2000	G.E.	N. Cond.	180	—
1	1000	Elliott	N. Cond.	325	1930
2	1000	Elliott	Cond.	150	1949
2	300	G.E.	Cond.	400	1945

PACKAGE BOILERS

Q	HP	MAKE	W.P.	FIRING	YEAR
3	80,000#	B&W	200	Coal	—
4	500	Cl. Bk.	200	Oil	1942
1	200	Superior	125	#6	1957
1	200	Erie	160	#6	1951
1	150	Cyclotherm	150	#6	1947
1	150	Cl. Bk	15	#6	1956
1	70	Ames	15	#2	1951

DIESEL GENERATOR SETS

Q	KW	MAKE	VOLTS	RPM
2	2000	Baldwin	230V.D.C.	237
2	1000	G.M.	3/60/2400	720
1	620	Alco	240V.D.C.	700
1	330	Worth.	3/60/480	600
1	300	G.M.	3/60/220-440	1200
2	200	G.M.	3/60/220-440	1200
2	125	Worth.	3/60/480	600

AIR COMPRESSORS

CFM	PSI	MAKE	TYPE	H.P.	VOLTAGE	RPM	YEAR
7550(2)	24/30	I.R.	XHE	600	3/60/4160	300	1948
6000	125	Sullivan	H	1250	3/60/2300	200	1943
1853	125	Worth.	DC-2	300	3/60/2300	277	1946
1530	125	Worth.	OXP	250	Steam	200	1948
1300	125	I.R.	XRE	225	3/60/440	257	1940
600	125	C.P.	OCE	125	440	277	1937
570	125	Gardner	WBK	150	3/60/440	870	1951
515(4)	125	I.R.	40	100	3/60/440	870	1940/50
494	125	I.R.	XRB	75	3/60	277	—
464	100	I.R.	ES-1	75	3/60	300	1950
368	100	I.R.	ER-1	60	3/60	277	Late
218	200	I.R.	40	50	3/60	870	Late
211	100	I.R.	E.S.	40	3/60	325	1948
174	125	Worth.	H	30	3/60	300	1940
173	100	I.R.	E.R.	30	3/60	300	1945
78	350	I.R.	ES-2	30	3/60	300	1954
8.8	2500	I.R.	ES-2	20	3/60	350	1945

"Everything from a Pulley to a Powerhouse"

THE O'BRIEN MACHINERY CO.

I. M. REGISTERED U. S. PATENT OFFICE

• Telephon:
BAldwin 8-1480
• Cable Address
OBRIEN PHILA.

MERCHANTS—CONSULTING ENGINEERS—EXPORTERS

OFFICES IN MEXICO, BRAZIL, COLOMBIA, ARGENTINA, PANAMA

Se Habla Espanól

1937 W. CLEARFIELD ST., PHILADELPHIA 32, PA.

Circle 525 on Reader Service Card

NEW EQUIPMENT FROM THE UNCOMPLETED

BATTLESHIP U.S.S. KENTUCKY

Installed but never used
Built of finest materials

WESTINGHOUSE 1250 K.W. TURBO-GENERATORS

(4)—Westinghouse—440/3/60—850°—540 lbs. working pressure. Complete with condensers, circulating pumps, etc.

BOILERS

7 B&W EXPRESS TYPE

Design pressure 634# — operating pressure 565# — temp. 850°F. Oil fired — separately fired superheaters. *Capacity: 210,000 lb.* steam/hr. ideal for testing where large quantities of steam are required, giving excellent control from separately fired superheaters. Can be converted for #2 oil and natural gas. Fully automatic.

LARGE DEAERATING FEED HEATERS

Monel construction — spray type — capacity 480,000 lbs./hr.—vent condenser—single pass —heating surface 174 sq. ft.—all Monel construction.

GE HIGH AND LOW PRESSURE MAIN PROPELLING TURBINES

Will sell separately for testing, wind tunnel or similar work. (2) high pressure—24,400 HP—12 impuse stages—4909 RPM—working pressure 540 lbs.—825°F. (2) low pressure—28,600 HP — 3913 RPM — working pressure 49 lbs. steam—424°F—2-6 stages of impulse.

FEED PUMPS

Ingersoll-Rand—5"—three stage—500 GPM at 750 lb. discharge. BHP 330—5000 RPM—Worthington turbine—573 lbs.—non-condensing—back pressure 20 lbs.

FORCED DRAFT BLOWERS

29,000 CFM—max. static 35"—normal 21".

LUBE OIL COOLERS

MANY OTHER ITEMS FOR SALE.
SEND US A LIST OF YOUR REQUIREMENTS

THE BOSTON METALS CO.

313 E. Baltimore St., Baltimore 2, Md.
ELGIN 5-5050 — LEXINGTON 9-1900

Circle 526 on Reader Service Card

TRANSFORMERS

BOUGHT · SOLD · RENTED
REWOUND · RE-DESIGNED
MANUFACTURED

Ask for our Stock List

For Sale

3—2500 KVA G-E 69000—2400/4160Y
3—2500 KVA G-E 69000—7200/12470Y
4—2500 KVA W-H 34500—2400/4800/11000
3—1500 KVA G-E 69000—2400/4160Y
3—1500 KVA G-E 69000—7200/12470Y
3—1000 KVA G-E 34500—7200/12470Y
3— 833 KVA W-H 43800—480

THE ELECTRIC SERVICE CO., 5322 Hetzel St., Cincinnati 27, Ohio
"America's Exclusive Independent Transformer Service Shop"

Circle 528 on Reader Service Card

POWER EQUIPMENT

20000 KW, *NEW*, Gas Turbo-Generator 3/60, 13800 V, 3600 RPM, Immediate shipment

1500 KW, Elliott, Cond. Turbo-Gen. 3/60, 2300 V, 5000/1200 RPM, 250 PSIG, 525°TT, geared.

1000 KW, G.E., Non C, Turbo-Gen. 3/60, 2300 V, 3600 RPM, 400 PSIG 600°TT, 90-125 PSIG, Exh.

1000 KW, Worthington, Non C, Turbo-Gen. 3/60, 240/480 V, 4500/1200 RPM, 155 PSIG, 470°TT, 5-10 PSIG Exh.

1000 KW, G.M. 16-278A, Diesel Units (2) 3 Ph. 60 cycle, 2300 V, 720 RPM.

300 KW, G.M. 8-268A, Diesel Units (2) 3 Ph. 60 cycle, 480 V, 1200 RPM.

BREW, WOLTMAN
& COMPANY, INC.
50 CHURCH ST., N.Y. 7, N.Y.

Circle 527 on Reader Service Card

DEAERATING FEED TANKS

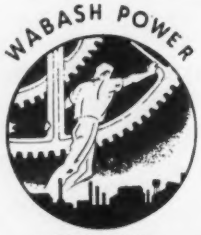
6—Cochrane vertical cylindrical deaerating feed tanks of STAINLESS STEEL. Upper Section: 8'-3" I.D. by 3'-7" high outside, contains direct contact feed water heater, internal deaerating atomizing valve assembly, external valve control unit, and a tubular surface type vent condenser. Lower Section: 10'-6" I.D. by 8'-2" high outside and used for storage of deaerated boiler feed water. Delivered capacity 414,500 pounds per hour of feed water maximum rating.

TURBINE-GENERATOR SETS

12—General Electric 600 KW, AC, 60 cycles, 450 volts, steam pressure 525 PSI at 825°. For prices or additional information Contact: Ralph E. Ingram

ZIDELL EXPLORATION, INC.
3121 S. W. Moody Ave., Portland 1, Oreg.
CApitol 8-8691

Circle 529 on Reader Service Card



BOILERS

TURBO-GENERATORS
PUMPS — FANS — VALVES
STEAM SPECIALTIES

LARGE SELECTION — NEW AND USED

SEND US YOUR REQUIREMENTS
EXPERIENCED ENGINEERS TO ASSIST YOU

WABASH POWER EQUIPMENT CO.
3300 W. PETERSON AVE., CHICAGO 45, ILL. TEL. IN 3-0303

Circle 530 on Reader Service Card

A. C. MOTORS—60 CYCLE

HP	Mfr.	Type	Volts	Speed
800	Whse. (2)	Sq. Cage	2300	1800
750	El. Machy.	Synch.	480	514
700	G.E.	Slipring	2300	514
600	G.E.	Synch.	480	900
600	Elliott (2)	Sq. Cage	2300	900
500	Al. Ch. 3 brg.	Slipring	440	514
500	G.E. b.b. (2)	Synch.	2300/440	1200
450	Allis Ch.	Sq. Cage	2300/440	720
400	Whse.	Sq. Cage	2200	514
400	Marathon (2)	Sq. Cage	2300	3600
400	G.E.	Slipring	2200/440	600
400	G.E.	Synch.	550/2200	400
400	Whse.	Sq. Cage	440	1200
350	G.E.	Slipring	440	900
350	El. Machy.	Synch.	2300	900
300	G.E.	Slipring	220/440	514
250	G.E.	Sq. Cage	440	1200
250	Gen. Elec.	Sq. Cage	440	3600
250	Whse.	Sq. Cage	2300/440	900
250	Whse. (4)	Slipring	2300/440	600
250	Whse.	Sq. Cage	2300/440	400
200	Gen. Elec.	Synch.	550/440	400
200	G.E. b.b.	Sq. Cage	220/440	720
200	G.E.	Slipring	220/440	450
200	G.E.	Slipring	440	600
200	G.E.	Slipring	2200	900
200	Reliance b.b.	Sq. Cage	220/440	1800
200	Allis Ch.	Slipring	2200/440	720
200	A.C. TEFC	Sq. Cage	220/440	1200
200	G.E.	Sq. Cage	2300	450
150	Whse. b.b.	Sq. Cage	440	1800
150	Whse. XP	Sq. Cage	440	3600
150	G.E. (4)	Slipring	2200/440	600
150	Whse.	Slipring	220/440	1200
150	Allis. Ch.	Sq. Cage	2300	900
150	Whse.	Sq. Cage	220/440	1200
150	G.E.	Sq. Cage	2200/440	600
125	Whse. b.b.	Sq. Cage	220/440	900
125	A.C. TEFC	Sq. Cage	220/440	1800
125	El. Machy. (2)	Synch.	220/440	400
125	G.E. TEFC	Sq. Cage	2200	3600
125	Al. Ch. TEFC	Sq. Cage	220/440	600
125	G.E. (2)	Slipring	220/440	514
125	G.E.	Sq. Cage	2300/440	1200
100	Allis Ch.	Slipring	2300/440	600
100	Al. Ch. TEFC	Sq. Cage	2200	1800
100	G.E. b.b.	Sq. Cage	220/440	3600
100	G.E. (2)	Slipring	220/440	1200
75	A.C. TEFC	Sq. Cage	2300/440	1200
75	Cent. b.b. (6)	Sq. Cage	220/440	1200
75	G.E.	Slipring	220/440	600

D. C. MOTORS

HP	Mfr.	Type	Volts	Speed
250	Cr. Wh.	101-H	230	1150
200	Whse. b.b.	SK	250	387/575
150	Rel. TEFC b.b.	2550-F	230	850
150	Whse.	SK-310	230	330/1000
125	G.E.	CD-173	230	575/1150
100	Elliott b.b. T.E.	JH-FE	230	1150
100	El. Dyn. b.b. (2)	30-S	230	450/1200
100	G.E. crane	CO-1831	250	675
75/100	Whse.	SK-191	230	300/900
75	Reliance b.b.	385T	230	850/1700
60	G.E. TEFC b.b.	CD-135	230	1150
30/40	L.A. b.b. (2)	ONW	230	500/1500

MOTOR-GENERATOR SETS

KW	Mfr.	Input V	Output V.
600	Allis Ch.	440 AC	250 DC
300	G.E.	440 AC	250/350 DC
200	Allis Ch. (2)	440 AC	250 DC
200	Whse. synch.	220/440 AC	55 DC
200	Gen. Elec.*	220/440 AC	125 DC
100	Delco b.b.	220/440 AC	120/240 DC
80	Star b.b. Synch	220/440 AC	250 DC
75	Whse. Synch.	220/440 AC	250 DC
60	Ideal	220/440 AC	125 DC
50	G.E.	220/440 AC	250 DC
30	G.E. (3)	220/440 AC	125 DC
30	Whse.	220/440 AC	250 DC

Arthur Wagner Co. Certified

MOnroe 6-7409

1435 W. RANDOLPH ST

CHICAGO 7, ILLINOIS

Circle 531 on Reader Service Card

SKINNER VERTICAL UNIFLOW

250 KVA, 480 volt, 3 phase, 60 cycle Skinner, 2 cylinder vertical used universal uniflow generating unit, steam pressure 150 to 175 pounds throttle pressure, 2 to 5 pounds back pressure.

Available for Immediate Shipment
From Original Foundations in Illinois.

FRANK M. BEESON ENGINEERING CO.

1511 W. 27th St., Los Angeles 7, Calif. • RE 5-9820

Circle 532 on Reader Service Card

COMPLETE STEAM POWER PLANT

NORTH LITTLE ROCK, ARKANSAS

(5)—Combustion Eng. Co. 435 HP, 4620 sq. ft. water-tube boilers, 3-drum low-head, 300 PSI, 34,500 lb. Saturated Steam per hour. Gas fired, with oil stand-by system. Built 1943, used very little. *Can be Sold or Leased on Site.*

PERRY EQUIP. CORP.
1422 N. Sixth St.
Philadelphia 22, Pa.
POplar 3-3505

Circle 533 on Reader Service Card

MODERN POWER BOILERS

1—Babcock & Wilcox	—122,000#s/hr	—250 psi
3—Combustion-Engineering	—110,000	—200 psi
1—Riley	—100,000	—456 psi
1—Babcock & Wilcox	—100,000	—450 psi
1—Babcock & Wilcox	— 90,000	—265 psi
1—Combustion-Engineering	— 75,000	—250 psi
1—Riley	— 70,000	—250 psi
2—Babcock & Wilcox	— 70,000	—450 psi
1—Riley	— 60,000	—290 psi
2—Combustion-Engineering	— 50,000	—250 psi
1—Babcock & Wilcox	— 45,000	—450 psi
1—Combustion-Engineering	— 40,000	—220 psi
1—Foster-Wheeler	— 40,000	—200 psi
1—Babcock & Wilcox	— 35,000	—300 psi
2—Riley	— 35,000	—250 psi
1—Babcock & Wilcox	— 27,500	—450 psi
2—Riley	— 19,000	—200 psi

MIDWEST BOILER & TURBINE CO.

WARNER NEW HAMPSHIRE PHONE 244

Circle 534 on Reader Service Card

1. One—1250 KVA, 1200 RPM, 240 volt, 3 phase, 60 cycle, E-M generator driven by a Worthington Turbine, 4507 RPM, 155 lb. steam pressure, 468° steam temperature, 1-lb per sq. in. back pressure. Installed new in 1949. Direct connected exciter. $15,000.00

2. One—300 KW, 375 KVA, 80% P.F., 200 RPM, 3 phase, 60 cycle, 240 volt, General Electric Company generator, driven by a 20" x 24" Nordberg uniflow steam engine. Complete with exciter. $1500.00

3. One—400 KW, 500 KVA, 80% P.F., 150 RPM, 3 phase 60 cycle, 240 volt, Westinghouse Electric Corporation generator driven by a 35" x 30" Erie City Lentz steam engine. Complete with exciter. $1500.00

4. One—280 KW, 350 KVA, 80% P.F., 150 RPM, 3 phase, 60 cycle, 240 volt, Fort Wayne Electric Company generator driven by a 21" x 27" Erie City Lentz steam engine. Complete with exciter. $1000.00

These units are coming out of service April 15, 1961. Our customer is changing to utility service due to the need for twice the power. See us for transformers, larger motors and power supplies.

ARTHUR G. PORTER

6345 Washburn Ave., S., Minneap. 23, Minn.

Phone — UNion 9-2434

Circle 535 on Reader Service Card

AUTOMATIC and MANUAL
Gas or DIESEL GENERATOR UNITS

Complete Switchboard Design and Construction

USED & REBUILT EQUIPMENT

UNIVERSAL POWER ENGINEERING CO.
382 Wayne St. Jersey City, N. J.
Phone: DElaware 2-8300

Circle 536 on Reader Service Card

RE-NU-BILT ELECTRICAL EQUIPMENT

53 YEARS SERVICE

MOTOR GENERATOR SETS

Qu.	KW	MAKE	RPM	AC VOLTS	DC VOLTS
2	4800	G.E.	450	2300/4600	250/300
1	2500	WHSE.	720	2300/4160	600
1	2100/2400	G.E.	450	2300/4600	250/300
2	1750/2100	G.E.	514	2300/4600	250/300
1	2000	G.E.	514	2300/4600	600/668
1	1500	G.E.	720	13200/6600	600
1	1250	WHSE.	720	2300/4000	600
1	1000	G.E.	900	2300/4000	600
1	1000	G.E.	900	6600/4000	260
1	1000	G.E.	720	2300/4000	275
1	500	G.E. Unused	1200	2300	300
1	500	G.E.	900	2300/4600	250
1	500	G.E.	900	440	250/125
2	300	G.E.	1200	2300	275
1	300	WHSE.	1200	2300/4160	600
1	200	G.E.	1200	2300/4160	250

FREQUENCY CHANGER SETS

Qu.	KW	MAKE	FREQ.	VOLTAGES
1	12500	WHSE.	60 To 25	13200-13200
1	5000	G.E.	60/50/60	11000-6600
1	2500	G.E.	60/24/60	2400-2400

3 PHASE 60 CYCLE MOTORS SLIP RING

Qu.	HP	MAKE	TYPE	VOLTS	SPEED
1	1750	G.E.	M-579BS	4800/2400	1800
1	800	G.E.	MT-428	2200	450
1	800	WHSE.	CW	550/2200	1776
1	600	WHSE.	CW-32D	440	1778
1	600	WHSE.	CW	440	850
1	550	WHSE.	CW	440	252
1	300	WHSE.	CW	2300	881
1	300	WHSE.	CW	550/2300	350
1	300	AL. CH.	ANY	2200	720
1	300	GEN. EL.	MTP-561	2200	1760

SQUIRREL CAGE

Qu.	HP	MAKE	TYPE	VOLTS	SPEED
3	1500	G.E.	K.D.P.	2300	3580
1	1000	AL. CH.	ANW	2300	1180
1	550/275	WHSE.	CS-1115	2300	863/445
2	500	WHSE.	CSP-583H D.P.	440	3600
4	500	AL. CH.	ARW-D.P.	2300	3600
2	450	EL.	FB3910	2200	1185
1	400	WHSE.	CS7151	6600	3565

OUTDOOR G.E. METAL CLAD SWITCHGEAR

600 V. 3 POLE, A.C.B.

1—3000 AMP., AL-2-75, ELEC. OPER.
1—1000 AMP. AL-2-50, MANUAL
4— 800 AMP, AL-2-50 MANUAL
1— 400 AMP., AL-2-50 MANUAL
3—SPARE COMPARTMENTS

PUMPS — MOTOR DRIVEN

6—600 G.P.M. Gould, Figure 3360, 8 Stage, 2310 Ft. Head, 1000#, 3550 RPM, Each coupled to 500 HP 3-60-3550 RPM D.P. Sq. Cage Motor

2—WHSE, Type CSP-583H, 440 volt

4—Allis Type 2300 volt Magnetic Encl. Reduced Voltage Starters

BELYEA COMPANY, INC.

43 Howell St., Jersey City 6, N. J.

Phone: OL 3-3334—N.Y.C. RE 2-7150

Circle 537 on Reader Service Card

Advertisers' Index

A

Air Preheater Corp. 97
Air Reduction Sales Co. 156
Allgemeine Elektricitats-Gesellschaft ..... •
Allis-Chalmers Mfg. Co. 48, 114-115
Allpax Company, Inc. ..... •
American Gilsonite Co. ..... •
American Oil Company 24-25
American Pulverizer Co. 98
American Standard
Industrial Div. ..... •
Ames Iron Works, Inc. ..... •
Anaconda American Brass Co. ..... •
Anchor Packing Co. 141
Anderson Co., V. D. ..... •
Armstrong Cork Co. 155
Armstrong Machine Works 39
Asea Electric, Inc. ..... •
Atomics International
A Div. of North American Aviation, Inc. 35
Aurora Pump Div.
New York Air Brake Co. 108

B

B-I-F Industries 166
Babbitt Steam Specialty Co. ..... •
Babcock & Wilcox Co.
Boiler Div. ..... •
Babcock & Wilcox Co.
Refractories Div. 60
Babcock & Wilcox Co.
Tubular Products Div. 23
Babcock & Wilcox Co.
Tubular Products Fittings Dept. 144
Bailey Meter Co. 4-5
Barco Manufacturing Co. ..... •
Barnes & Jones, Inc. 180
Bell & Gossett Co. ..... •
Belmont Packing & Rubber Co. 96
Biddle Co., James G. 130
Black, Sivalls & Bryson, Inc. 37
Boiler Tube Co. of America 124
Bonney Forge & Tool Works ..... •
Borg-Warner Mechanical Seals ..... •
Buell Engineering Co. ..... •
Buffalo Forge Co. 41
Bussmann Mfg. Div.
McGraw Edison Co. ..... •
Butler Manufacturing Co. ..... •
Byron Jackson Pumps Inc.
Subsidiary of Borg-Warner Corp. 157

C

Carling Turbine Blower Co. 164
Catawissa Valve & Fittings Co. 166
Chesterton Co., A. W. 122
Chicago Pneumatic Tool Co. 180B-180C
Clarage Fan Co. 26
Clark Bros.
One of the Dresser Industries ..... •
Clayton Manufacturing Co. ..... Third Cover
Cleaver-Brooks Company ..... •
Cochrane Division
Crane Company 173
Combustion Engineering, Inc. 18-19
Condenser Service & Engrg. Co. ..... •
Cooper-Bessemer Corp. 175
Copes-Vulcan Div.
Blaw-Knox Company 8-9
Coppus Engineering Corp. ..... •
Corning Glass Works ..... •
Crane Company 27
Crane Packing Co. ..... •
Crawford Fitting Co. ..... •

D

Darling Valve & Mfg. Co. ..... •
Dearborn Chemical Co. 1
DeLaval Steam Turbine Co. ..... •
Detroit Stoker Company 127
DeVar Systems Inc.
Div. of General Kinetics Inc. ..... •
DiVilbiss Company ..... •
Diamond Power Specialty Corp. 6-7
Dodge Manufacturing Corp. 34
Dow Chemical Co. ..... •
Dow Corning Corp. ..... •
Dow Industrial Service
Div. of Dow Chemical Co. 32
DuPont de Nemours & Co., Inc. E. I.
Industrial & Biochemical Dept. ..... •
DuPont de Nemours & Co., Inc., E. I.
Polychemicals-Teflon ..... •

E

Eagle-Picher Company 28
Eastern Gas & Fuel Associates ..... •
Edison Industries, Thomas A.
Instrument Div. ..... •
Edward Valves, Inc. ..... •
Electric Machinery Mfg. Co. 42
Electric Storage Battery Co. 90
Elgin Softener Corp. 22
Elliott Company 12-13
Elliott Company—Lagonda Plant ..... •
Elliott Company—Roto Plant 131
Engineer Company 156
Everlasting Valve Co. ..... •

F

Fairbanks, Morse & Co. 142-143
Field Control Div.
Conco Engrg Works, Inc. ..... •
Fisher Governor Co. 43, 124, 165
Flexitallic Gasket Co. ..... •
Flexonics Div. of Calumet & Hecla, Inc. 53
Flour Products Co. 153
Foster Co., Benjamin 17
Foster Wheeler Corp. 29
Foxboro Company ..... •
Fuller Company 216

G

Garden City Fan & Blower Co. ..... •
Gardner-Denver Co. 160
Garlock Incorporated 171
General Controls 52
General Electric Co. 182-183
General Precision, Inc.
Kearfott Division 172
Goulds Pumps, Inc. ..... •
Grinnell Company 94
Gustin-Bacon Mfg. Co. 148, 149

H

Hitachi, Ltd. 55
Hoffman Specialty Mfg. Corp. 159
Hungerford & Terry, Inc. 112
Hupp Aviation Div.
Hupp Corp. ..... •

I

I-T-E Circuit Breaker Co. ..... •
Illinois Water Treatment Co. 149
Industrial Combustion, Inc. ..... •
International Nickel Co., Inc.
Huntington Alloy Products Div. 179
International Salt Co. ..... •
Iron Fireman Mfg. Co. ..... •

J

Jenkins Bros. 58-59
Johns Hopkins Press ..... •
Johns-Manville ..... •
Johnson Service Co. 20-21

K

Keasbey & Mattison Co. 145
Keeler Co., E. ..... •
Kerrigan Iron Works Co. ..... •
Kieley & Mueller, Inc. 99
Kirk & Blum Mfg. Co. ..... •
Koppers Co., Inc.
Couplings Dept. ..... •
Koppers Co., Inc.
Electrostatic Precipitators 33
Kuljian Corp. ..... •

L

Leslie Company 184
Limitorque Corp. ..... •
Link-Belt Company 161
Liquidometer Corp. 126
Lunkenheimer Company ..... Second Cover

M

Madden Corp. ..... •
Magnatrol Valve Corp. 156
Manning, Maxwell & Moorse, Inc. 16, 116
Marley Company 36
Marsh Instrument Company
Div. of Colorado Oil & Gas Corp. 102
Mason-Neilan
Div. of Worthington Corp. ..... •
McDonnell & Miller, Inc. 176
McGraw-Hill Book Co. 117
Meaker Company
Sub. of Sel-Rex Corp. 111
Mears Kane Ofeldt, Inc. ..... •
Mercoid Corp. ..... •
Metropolitan Refining Co. ..... •
Michigan Seamless Tube Co.
Gulf States Tube Corp. ..... •
Midwest Piping a Div. of Crane Co. 105
Minneapolis-Honeywell 107
Morton Salt Co.
Industrial Div. ..... •
Murray Mfg. Co., D. J. ..... •

N

Nalco Chemical Co. 121
National Tube
Div. of U. S. Steel ..... •
Nicholson & Co., W. H. 110
Nordberg Manufacturing Co. 169
Norfolk & Western Railway 44-45
North American Mogul Products Co. ..... •
Norwalk Company, Inc. 178
Novenco Inc. 167

O

OPW-Jordan Corp. ..... •
Ohio Injector Co. 91
Onan Division
Studebaker-Packard Corp. 46-47
Orr & Sembower, Inc. ..... •

This index is a service to readers. Every effort is made to maintain its accuracy, but POWER cannot assume responsibility for errors or omissions. When a star appears after the name, the advertisement does not appear in this issue but appeared in an issue within the previous three months.

P

Patterson-Kelley Co. 113
Peabody Engineering Corp. ..... *
Peerless Pump, Hydrodynamics Div. Food Machy. & Chemical Corp. 129
Penberthy Mfg. Co. 154
Pennsylvania Crusher Div. Bath Iron Works Corp. 54
Pennsylvania Flexible Metallic Tubing Co. *
Pfaudler Permutit, Inc. 100
Pfizer & Co., Inc., Charles Chemical Sales Div. ..... *
Phelps Dodge Copper Products Corp. ..... *
Philadelphia Gear Corp. ..... *
Pipe Fabrication Institute ..... *
Pittsburgh Plate Glass Co. Fiber Glass Div. 49
Plibrico Company 89
Powell Co., Wm. 56
Powers Regulator Co. 95
Pratt Company, Henry ..... *

R

R-P & C Valve Div. Amer. Chain & Cable Co., Inc. ..... *
Raybestos-Manhattan, Inc. Manhattan Rubber Div. ..... *
Raybestos-Manhattan, Inc. Packing Div. 174
Reliance Gauge Column Co. 168
Republic Flow Meters Co. 30-31
Republic Steel Corp. 132-133
Research-Cottrell, Inc. 38
Revere Copper & Brass, Inc. ..... *
Ric Wil Incorporated ..... *
Ridge Tool Company 106
Riggio Co., Inc. Frank D. ..... *
Riley Stoker Corporation 84-85
Robvon Backing Ring Co. 138
Rohm & Haas Co. 181

S

Sarco Company, Inc. 50
Sargent & Lundy Engineers ..... *
Scam Instrument Corp. 120
Schaub Engineering Co., Fred H. ..... *
Schoonmaker Co., Inc., A. G. ..... *
Scovill Mfg. Co. ..... *
Shell Oil Co. 177
Smith Corp., A. O. 138
Spence Engineering Co. 40
Stephens-Adamson Mfg. Co. ..... *
Stickle Steam Specialties Co. 120
Stock Equipment Co. 10-11
Superior Combustion Industries, Inc. 139

T

Tennant Development Corp. ..... *
Terry Steam Turbine Co. 123
Thermo Electric Co., Inc. 152

U

Union Asbestos & Rubber Co. Fibrous Products Div. ..... *
Union Iron Works 180D
United Engineers & Constructors Inc. ..... *
United States Motors Corp. 158
Universal Atlas Cement Div. of U. S. Steel 109

V

Valley Camp Coal Co. ..... *
Van Products Co. 164
Viking Pump Co. 159
Vogt Machine Co., Henry 87

W

Wallace & Tiernan, Inc. ..... *
Wallingford Steel Co. 128
Western Chemical Co. ..... *
Western Precipitation 51
Westinghouse Electric Corp. 147
Where to Buy 207
Whitey Research Tool Co. 137
Wickes Boiler Co. ..... *
Wiedeke Co., Gustav 112
Williams Gauge Co. ..... *
Wolverine Tube Div of Calumet & Hecla, Inc. ..... *
Worthington Corp. ..... 170, Back Cover
Wright-Austin Co. ..... *

Y

Yarnall-Waring Company 14-15, 151
York Corporation Subsidiary of Borg-Warner Corp. 180A
Yuba Consolidated Industries, Inc. 125

Z

Zallea Brothers 101

Professional Services **207**

CLASSIFIED ADVERTISING

F. J. Eberle, Business Mgr.

EMPLOYMENT OPPORTUNITIES . 207, 208
EQUIPMENT (Used or Surplus New)
For Sale 208-213
WANTED Equipment 208

ADVERTISERS' INDEX

Allied Electric Co. 208
American Air Compressor Corp. 210

Bechtel Corporation 208
Beeson Engineering Co., Frank M. 213
Belyea Co., Inc. 213
Boston Metals Co. 209, 210, 211, 212
Brew, Woltman and Co., Inc. 212

Chicago Electric Co. 211
Clinton Corn Processing Co. 208

Drew Co., Inc., E. F. 207
Duffy & Son, Preston W. 208

Ebasco Services, Inc. 210
Electric Equipment Co. 210
Electric Service Co. 212
Empire Electric Co., Inc. 208

Hall and Co., Stephen 209
Heat & Power Co., Inc. 211
Hemphill and Co., J. L. 211

Indeck Power Equipment Co. 209, 210
International Power Machinery Co. 210

Kaiser-Nelson Steel & Salvage Corp. 210
Kuljian Corp. 211

Machinery Expeditors 208
Midwest Boiler and Turbine Co. 213

National Aniline Div., Allied Chemical Corp. 208

O'Brien Machinery Co. 212

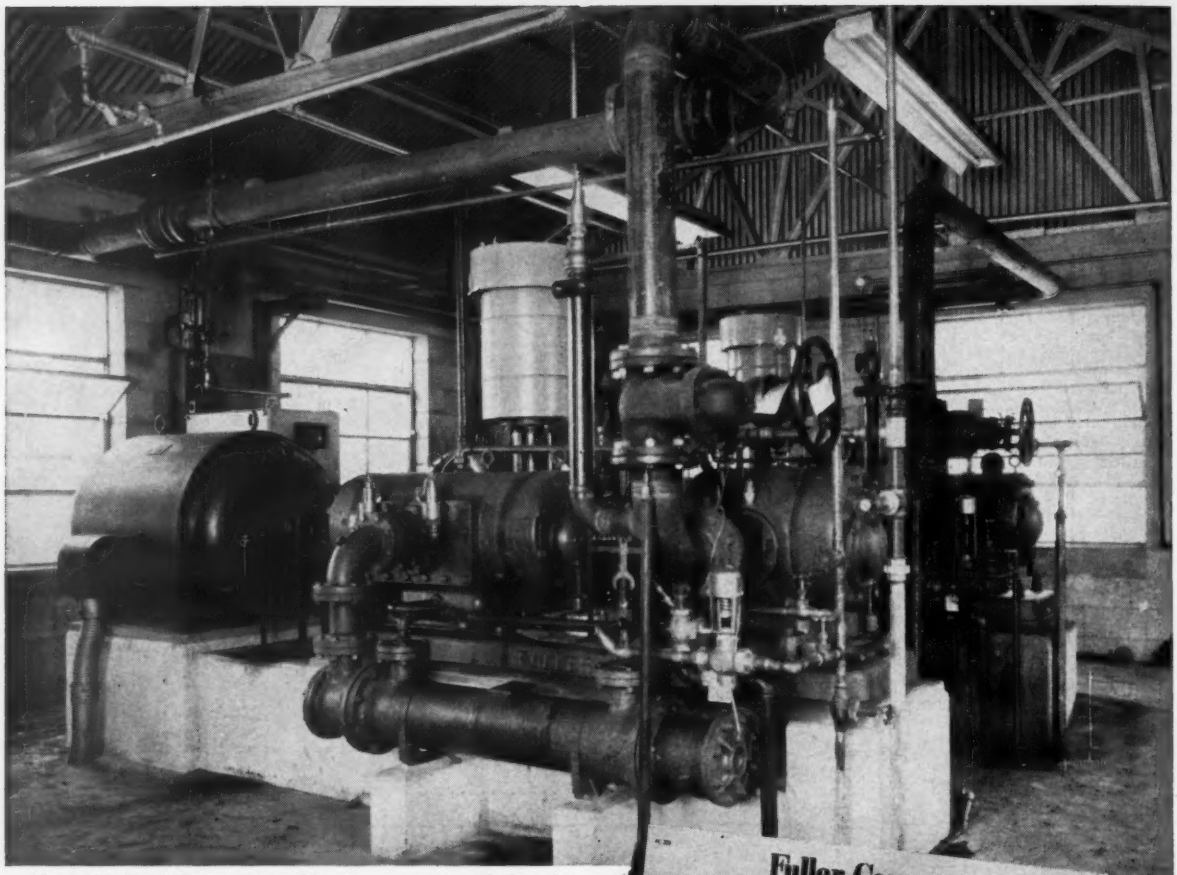
Pelnik-Loconti Industrial Supply 210
Perry Equipment Co. 213
Porter, Arthur G. 213
Power Equipment Co. 211

Scott Paper Co. 208
Southern Methodist University 208

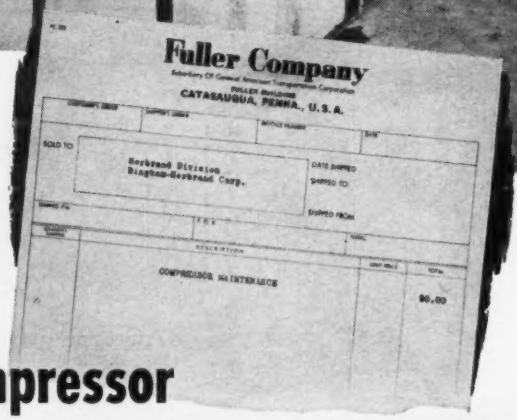
Universal Power Engineering Co. 213

Wabash Power Equipment Co. 212
Wagner Co., Arthur 213
Weaver Inc., Charles 209
Whisler Equipment Co. 210
White Electric Motors 208
Worthington Corp. 208

Zidell Exploration, Inc. 212



Two C135/135H Fuller Rotary Compressors at the Herbrand Division of the Bingham-Herbrand Corp., Fremont, Ohio, leading manufacturer of forged mechanics' hand tools and steel forgings for the automotive industry. Each compressor is rated 680 cfm, atmosphere to 100/110 psig., at 690 RPM.



Here's the 4-Year Maintenance Bill on Fuller Rotary Compressor at Herbrand Division of Bingham-Herbrand Corp.

So satisfactory was the performance of its first Fuller Rotary Compressor, installed in 1956, that Herbrand Division installed another like it 3½ years later.

When the older unit was inspected after four years operation, no replacement of parts was necessary. After installation of a new gasket (cost $9.35)—to replace the one that had to be removed to make inspection—the compressor continues to add to its service record.

The newer compressor has also been entirely trouble-free, and Herbrand plans a third, when increased air capacity is required. It, too, will be a Fuller—for, as Herbrand says, "These compressors can be classified as maintenance-free."

Because Fuller Rotary Compressors are practically vibration-free, they can be installed without complicated or expensive foundations or structural modifications. They are simple and efficient, with no valves to leak, no seats to grind. Blades automatically compensate for wear. They have forced-feed lubrication to all parts within the cylinder. Rotor, bearings and blades are the only moving parts.

Fuller Compressors range from 30 to 3300 cfm, pressures to 125-lb. gauge.

Write for Bulletin C-5A. It tells the whole story.

See Chemical Engineering Catalog for further details and specifications.

FULLER COMPANY GENERAL AMERICAN TRADE MARK

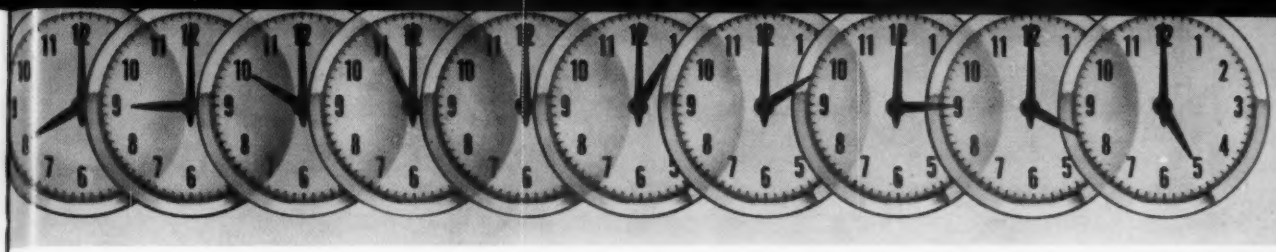
FULLER COMPANY
126 Bridge St., Catasauqua, Pa.
Subsidiary of General American Transportation Corporation
Offices in Principal Cities Throughout the World

Fuller
....pioneers in harnessing AIR

2852
C-364

For more facts circle 339 on Reader Service card, p 103

Circle 202 on Reader Service card for Clayton ad ➤
Circle 203 on Reader Service card for Worthington ad ➤



EVERY WORKING HOUR OF EVERY DAY- SOMEONE MODERNIZES WITH CLAYTON

... because savings in space, fuel costs and production time are bringing new profit potential to Clayton users the world over. If your steam requirements range from 500 to 65,000 pounds per hour, or more, you can profit substantially from Clayton STEAM THE MODERN WAY. Write, wire or phone Clayton for all the facts.

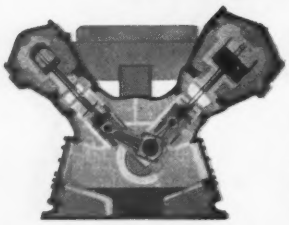
Clayton Steam Generators

CLAYTON MANUFACTURING COMPANY
465 North Temple City Blvd. • El Monte, California

Write for free model boiler room on your letterhead. Graphically portrays actual space-weight savings available to you in your own plant.

426

Will your next Y-type compressor have all of these HIDDEN VALUES?



Frankly, it won't! Twenty-four of the values contribute to Worthington Y-type compressor performance. The other is fictitious—to see if you know enough about compressor quality to identify it. See page 208 for the *real* fictitious feature.

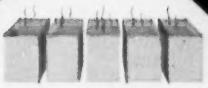
As you decide which 24 values are real, remember that they're not the obvious characteristics that show up on pressure gauges or price tables. They are true "values" that reveal themselves in your maintenance records ten years hence—when you find out that "those Worthington's are least expensive to run." Next time you specify a compressor, please see your local Worthington representative. Worthington Corporation, Compressor and Engine Division, Buffalo, N.Y. 36-9

$1,000,000 ADDITION TO LABORATORY assures sound equipment designs based on actual research.

COMPOSITION TEST determines constituents of molten iron in each ladle before any casting is poured.

OPTIC COMPARATOR is used to check connecting rod bolt threads for uniform angles, lead and form.

MAGNAFLUX AND MAGNAGLO inspections are widely used to expose surface imperfections.

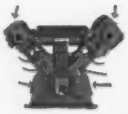


PARCO-LUBRITING of critical wearing surfaces completely eliminates most start-up scuffing problems.

2000 CRAFTSMEN, these units built by same men who design and build large 5000 hp, 15,000 psi units.

COUNTERWEIGHTED CRANKSHAFT eliminates vibration and insures a smoother operation.

SELF-CLEANING OIL FILTER turns continuously to insure clean oil for pressure lubricating system.

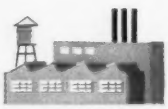


ACCESSIBILITY – valves, packing and main parts are easily observed and reached by operators.

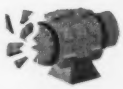
FAST SHIPMENT– two-stage 100-125 psi units are continuously stocked items, for quick shipment.

WATER-COOLED CRANKCASE keeps oil and compressor running gear at proper temperature.

CAPACITY CONTROL by-pass unloading, cool-operating suction valve unloaders, 3 step or 5 step option.



INTEGRATED DIV. includes foundry, manufacturing, sales, service and engineering in one location.



DESTRUCTION TEST of complete compressor cylinders verifies engineers' design calculations.

ASME DESIGN INTERCOOLER of straight tube construction externally mounted, is readily accessible.

CHOICE OF DRIVE – Flange mounted, Multi-V belt or direct coupled with tapered shaft, easy mounting.

ARTICULATED CONNECTING ROD reduces crankshaft length, reduces weight and gives fewer parts.

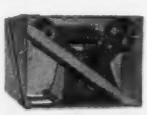
FEATHER VALVE – industry's preferred compressor valve—is efficient, quiet, and low in maintenance.

SALES AND SERVICE INTEGRATION recognizes kinship of one to the other. One man administers both.

HONING of connecting rod crankpin and crosshead pin ends results in tighter fits, no loose shells.

PROFILOMETER inspection of highly finished parts assures easy break-in and long life.

ADJUSTABLE ROLLER MAIN BEARINGS feature low friction losses which help to extend compressor life.



PACKAGE UNIT shipped assembled—factory alignment unchanged and no field adjustment needed.

REMOVABLE DOWEL locks piston rod to crosshead—prevents turning due to loosened crosshead nut.

ULTRASONIC TEST– an advanced method of examining certain critical parts for internal quality.

?

NGTO

EST –
ethod
rtain
r in-